

PERIODICAL ROOM  
GENERAL LIBRARY  
UNIV. OF MICH

OCT 2 1928

# NATURAL HISTORY

Sept.-Oct.  
1928

Price Fifty  
Cents



JOURNAL OF THE AMERICAN  
MUSEUM OF NATURAL HISTORY  
NEW YORK, N. Y.

# THE AMERICAN MUSEUM OF NATURAL HISTORY

## Scientific Staff for 1928

HENRY FAIRFIELD OSBORN, LL.D., President  
GEORGE H. SHERWOOD, A.M., Ed.D., Director and Executive Secretary  
JAMES L. CLARK, Assistant Director, Preparation  
FREDERIC A. LUCAS, Sc.D., Honorary Director  
WAYNE M. FAUNCE, Sc.B., Assistant to the Director and Assistant Secretary

### I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

HENRY FAIRFIELD OSBORN, LL.D., D.Sc., Curator-in-Chief

#### *Astronomy*

G. CLYDE FISHER, Ph.D., LL.D., Curator

#### *Minerals and Gems*

HERBERT P. WHITLOCK, C.E., Curator  
GEORGE F. KUNZ, Ph.D., Research Associate in Gems  
LEA MCLIVAIN LUQUER, Ph.D., Research Associate in Optical Mineralogy

#### *History of the Earth*

HENRY FAIRFIELD OSBORN, LL.D., D.Sc., Honorary Curator-in-Chief

#### *Fossil Vertebrates*

WALTER GRANGER, Curator of Fossil Mammals  
BARNUM BROWN, A.B., Curator of Fossil Reptiles  
CHARLES C. MOOK, Ph.D., Associate Curator of Fossil Reptiles  
GEORGE G. SIMPSON, Ph.D., Assistant Curator of Vertebrate Paleontology  
WILLIAM K. GREGORY, Ph.D., Research Associate in Paleontology  
CHILDS FRICK, B.S., Research Associate in Paleontology

#### *Geology and Fossil Invertebrates*

CHESTER A. REEDS, Ph.D., Curator

### II. DIVISION OF ZOÖLOGY, AND ZOÖ-GEOGRAPHY

FRANK MICHLER CHAPMAN, Sc.D., N.A.S., Curator-in-Chief

#### *Marine Life*

ROY WALDO MINER, Ph.D., Sc.D., Curator  
WILLARD G. VAN NAME, Ph.D., Associate Curator  
FRANK J. MYERS, B.A., Research Associate in Rotifera  
HORACE W. STUNKARD, Ph.D., Research Associate in Parasitology  
A. L. TREADWELL, Ph.D., Research Associate in Annulata

#### *Insect Life*

FRANK E. LUTZ, Ph.D., Curator  
A. J. MUTCHLER, Associate Curator of Coleoptera  
C. H. CURRAN, M.A., Assistant Curator  
FRANK E. WATSON, B.S., Assistant in Lepidoptera  
WILLIAM M. WHEELER, Ph.D., Research Associate in Social Insects  
CHARLES W. LENG, B.S., Research Associate in Coleoptera  
HERBERT F. SCHWARTZ, A.M., Research Associate in Hymenoptera

#### *Fishes*

WILLIAM K. GREGORY, Ph.D., Curator  
BASHFORD DEAN, Ph.D., Honorary Curator  
JOHN T. NICHOLS, A.B., Curator of Recent Fishes  
E. W. GUDGER, Ph.D., Bibliographer and Associate  
FRANCESCA R. LAMONTE, A.B., Assistant  
CHARLES H. TOWNSEND, Sc.D., Research Associate  
C. M. BREDER, JR., Research Associate  
VAN CAMPEN HEILNER, M.Sc., Field Representative

#### *Amphibians, Reptiles, and Experimental Biology*

G. KINGSLEY NOBLE, Ph.D., Curator  
CLIFFORD H. POPE, B.A., Assistant Curator  
BERTRAM G. SMITH, Ph.D., Research Associate  
A. B. DAWSON, Ph.D., Research Associate  
WILLIAM DOUGLAS BURDEN, A.M., Research Associate

#### *Birds*

FRANK M. CHAPMAN, Sc.D., Curator-in-Chief  
ROBERT CUSHMAN MURPHY, D.Sc., Curator of Oceanic Birds  
W. DEW. MILLER, Associate Curator  
JAMES P. CHAPIN, Ph.D., Associate Curator of Birds of the Eastern Hemisphere  
JONATHAN DWIGHT, M.D., Research Associate in North American Ornithology  
ELSIE M. B. NAUMBURG, Research Associate

#### *Mammals of the World*

H. E. ANTHONY, M.A., Curator  
ROBERT T. HATT, A.M., Assistant Curator  
GEORGE G. GOODWIN, Assistant  
FREDERIC A. LUCAS, Sc.D., Research Associate  
WILLIAM J. MORDEN, Ph.B., Field Associate

#### *Comparative and Human Anatomy*

WILLIAM K. GREGORY, Ph.D., Curator  
H. C. RAVEN, Associate Curator  
S. H. CHUBB, Associate Curator  
J. HOWARD MCGREGOR, Ph.D., Research Associate in Human Anatomy  
DUDLEY J. MORTON, M.D., Research Associate

### III. DIVISION OF ANTHROPOLOGY

CLARK WISSLER, Ph.D., Curator-in-Chief

#### *Science of Man*

CLARK WISSLER, Ph.D., Curator-in-Chief  
N. C. NELSON, M.L., Curator of Prehistoric Archaeology  
HARRY L. SHAPIRO, Ph.D., Assistant Curator of Physical Anthropology  
MARGARET MEAD, Ph.D., Assistant Curator of Ethnology  
GEORGE C. VAILLANT, Ph.D., Assistant Curator of Mexican Archaeology  
WILLIAM K. GREGORY, Ph.D., Associate in Physical Anthropology  
CLARENCE L. HAY, A.M., Research Associate in Mexican and Central American Archaeology  
MILO HELLMAN, D.D.S., Research Associate in Physical Anthropology

### IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

ROY C. ANDREWS, D.Sc., Curator-in-Chief  
WALTER GRANGER, Curator in Paleontology  
CHARLES P. BERKEY, Ph.D. [Columbia University], Research Associate in Geology  
FREDERICK K. MORRIS, A.M. [Central Asiatic Expeditions], Associate in Geology and Geography  
AMADEUS W. GRABAU, S.D. [Geological Survey of China], Research Associate

### V. DIVISION OF EDUCATION AND PUBLICATION

GEORGE H. SHERWOOD, A.M., Ed.D., Curator-in-Chief

#### *Library and Publications*

IDA RICHARDSON HOOD, A.B., Acting Curator  
HAZEL GAY, Assistant Librarian  
JANNETTE MAY LUCAS, B.S., Assistant Librarian—Osborn Library

#### *Education and Public Health*

GEORGE H. SHERWOOD, A.M., Ed.D., Curator-in-Chief  
G. CLYDE FISHER, Ph.D., LL.D., Curator of Visual Instruction  
GRACE FISHER RAMSEY, Associate Curator  
WILLIAM H. CARR, Assistant Curator  
NANCY TRUE, A.B., Assistant  
PAUL B. MANN, A.M., Associate in Education  
FRANK E. LUTZ, Ph.D., Research Associate in Outdoor Education  
CHARLES-EDWARD AMORY WINSLOW, D.P.H., Honorary Curator of Public Health  
MARY GREIG, A.B., Assistant Curator of Public Health

#### *Printing and Publishing*

HAWTHORNE DANIEL, Curator, and Editor of *Natural History*  
A. KATHERINE BERGER, Associate Editor of *Natural History*

#### *Public Information*

GEORGE N. PINDAR, Chairman  
GEORGE H. SHERWOOD, A.M., Ed.D.  
WILLIAM K. GREGORY, Ph.D.  
WAYNE M. FAUNCE, Sc.B.  
CLARK WISSLER, Ph.D.  
HAWTHORNE DANIEL

### Advisory Committee on Natural History Magazine

HAWTHORNE DANIEL, Chairman  
HENRY FAIRFIELD OSBORN, LL.D., D.Sc.  
CLARK WISSLER, Ph.D.  
GEORGE N. PINDAR

FRANK M. CHAPMAN, Sc.D.  
FRANK E. LUTZ, Ph.D.  
GEORGE H. SHERWOOD, A.M., Ed.D., *ex-officio*

A. KATHERINE BERGER

VOLUME XXVIII  
NUMBER 5

# NATURAL HISTORY

SEPT.-OCT.  
1928

*The Journal of The American Museum of Natural History*

HAWTHORNE DANIEL  
*Editor*



A. KATHERINE BERGER  
*Associate Editor*

## CONTENTS

TRAIL BREAKERS OF THE ARCTIC AIR .....	Cover
Painted by Arthur A. Jansson	
AN ENCHANTED FOREST OF THE MICROSCOPE .....	Frontispiece
BY AIR TO THE ENDS OF THE EARTH .....	Vilhjalmur Stefansson 451
The Present and the Future in Polar Exploration	
THE CROCKER LAND EXPEDITION .....	Fitzhugh Green 463
The Story of the Last Extensive Dog Sled Expedition in the Arctic	
BR'ER RABBIT'S WIDESPREAD FAMILY .....	Robert T. Hatt 476
Rabbits and Hares of America	
MARCO POLO'S SHEEP .....	William J. Morden 486
<i>Ovis poli</i> Among the Russian Pamirs	
A DRAMA OF THE MICROSCOPE .....	Roy Waldo Miner 501
Dragons and Gnomes of the Microscopical World	
FLYING SHADOWS OF THE NIGHT .....	G. G. Goodwin 515
Some of the Strange Creatures We Call Bats	
BIRDS OF AFRICA'S BIG GAME FIELDS .....	James P. Chapin 523
Feathered Residents of the Land of Lions	
THE LEAPING TARPON .....	Van Campen Heilner 539
One of the Very Finest of the Game Fish	
LIFE IN MINIATURE .....	Edward J. Burns 546
Models in Wax and Other Media for Museum Displays	
NOTES .....	555

---

Published bimonthly, by The American Museum of Natural History, New York, N. Y. Subscription price \$3.00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership.

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

Copyright, 1928, by The American Museum of Natural History, New York



AN ENCHANTED FOREST OF THE MICROSCOPIC WORLD

A detail of the new Rotifer Group in the Darwin Hall of the American Museum, constructed entirely of glass, and faithfully portraying many of the strange plants and animals that normally might be found in one half inch of pond bottom, magnified to more than four feet in diameter



VOLUME  
XXVIII

# NATURAL HISTORY

NUMBER  
FIVE

SEPTEMBER-OCTOBER, 1928



## BY AIR TO THE ENDS OF THE EARTH

Modern Methods in Polar Exploration. The Difficulties and Advantages of Arctic and Antarctic Air Routes. The Problems to be Faced in Air Travel in the Antarctic

BY VILHJALMUR STEFANSSON

WHEN Byrd and Wilkins, two of the chief heroes of northern flying, go south this autumn to face tragedy or triumph in the Antarctic, we turn naturally to a study of the contrasts and comparisons that describe the two ends of the earth.

The similarities are fundamental, of course. At the mathematical poles, whether north or south, you have the sun visible above the horizon for about one week more than six months, and there is darkness so that you could not read ordinary newspaper print out of doors for something between four and five months each year. But this is never pitch darkness such as we know in the tropic or temperate zones. Clouds are rare in the Arctic in midwinter and are even fewer and thinner toward the center of the Antarctic, so that the light of the stars comes through in both places. Auroras ranging from gorgeous to pale are common, too, and a medium aurora gives about as much light as the combined brightness of all the stars. On a moonless but cloudless night you could therefore see a man dressed in black half a mile away. With even a quarter of the moon in addition,

you could see him as a dot on the landscape three or four times that far. When the moon is anything from half to full, you can see mountain peaks no matter how far away if they are above the horizon. Even on a cloudy night with no moon, you could see a figure in black one or several hundred yards distant, for in winter there is snow over both land and the sea in the Arctic that reflects and doubles the light. In the Antarctic there is snow both winter and summer.

So far as light is concerned, you can therefore do night flying with greater ease and safety in the Arctic or Antarctic than you could in the rest of the world.

For winter flying, cold is not a handicap at either end of the earth, so long as you are in the air. Cold has, on the contrary, the slight advantage that it makes the air heavier, and that the airplane can therefore carry more weight or rise more easily with the same weight. It has, too, the greater advantage that the lower the mercury the calmer the weather and the more clear. Since clouds and fog are the greatest enemies of the flyer, cold is to that extent his best friend.

But after a forced landing, extreme cold



*Copyright by Underwood & Underwood*

#### THE MOUNTAINS OF SPITSBERGEN FROM THE AIR

Between Spitsbergen and the North Pole the aviator flies over no such peaks as these, for the North Pole lies near the center of a frozen sea. This photograph, however, gives some idea of what the aviator must face in attempting the flight to the South Pole, which lies near the center of a rugged, ice-clad continent

may well be a drawback. It is hard to work on metal with metal tools except when using mittens, and they are clumsy when handling small or delicate things. It has been estimated by some that, other things being equal, it is at least  $30^{\circ}$  colder in the Antarctic than in the Arctic, and my own opinion is that the difference is probably greater. A forced landing in winter, in that respect, would be more dangerous in the Antarctic. This is a purely academic situation, however, for, as we shall show when we discuss contrasts, there is every reason for midwinter Arctic flying and no reason for midwinter Antarctic flying.

The two magnetic poles are located near the edges of the Arctic and Antarctic circles, each more than a thousand miles from the mathematical pole. The difficulty in using ordinary magnetic compasses has everything to do with the magnetic

poles and nothing with the mathematical ones. There are commonplace shipping routes in the temperate zone that are nearer the north magnetic pole and more influenced by it than if they lay across the mathematical north pole. It is therefore merely one of the common mistakes to suppose that flying in either the Arctic or the Antarctic is necessarily more difficult than in the temperate zone because of magnetic conditions. Wilkins, for instance, when he flew across the Arctic from Point Barrow to Spitsbergen, was never in greater difficulty with magnetic forces than the ships of the Hudson's Bay Company have been every year for the last two hundred fifty when taking their cargoes from England to the fur posts on Hudson Bay. The magnetic troubles of Byrd when flying between Spitsbergen and the North Pole were even

less; in fact, no more than those of passenger ships that ply between Liverpool and Montreal.

A fundamental similarity of the far north and the far south is that snow and ice are permanent throughout the twelve months of the year only on mountains or where low land is so near a mountain that the ice which forms in high altitudes can flow down upon the plain. This similarity leads to a contrast, for the Antarctic is higher above sea level than any other equally large area in the world. More than 99 per cent of the known Antarctic continent is therefore covered with ice. But the Arctic lands are usually low; in consequence less than 25 per cent of them have a permanent ice covering. The rest of the Arctic lands have snow in winter which all goes away in summer.

The contrasts between the Arctic and the Antarctic are even more fundamental

than the similarities, and they are more numerous. To begin with, the Arctic is mainly water while the Antarctic is mainly land.

The Antarctic is a continent larger than Australia or Europe. But the Arctic is an "ocean" only by courtesy, or perhaps, more rightly speaking, by mistake. For it is only on Mercator projection maps that it looks big, which is only because everything far from the tropics is magnified. On a map of approximately uniform scale, or on a globe, where you can get the strictly right proportions, you will see that the Arctic is a mere gulf running north from the Atlantic. More properly, it is a mediterranean sea separating North America from Asia somewhat as the old Mediterranean separates Europe from Africa.

The position of the Antarctic surrounded by ocean and the Arctic surrounded by land makes a fundamental



*Mawson Australasian-Antarctic Expedition*

#### THE EDGE OF THE ANTARCTIC CONTINENT

The Antarctic land mass rises from the ice-infested southern seas to altitudes of ten thousand feet or more. Covered almost entirely by ice and snow and surrounded by water, this portion of the globe is a breeding place of storms, although at the pole itself it is probable that storms are rare and that the winds are generally mild

difference in human values. We have no economic or other so-called practical motives for wanting to cross the Antarctic by flying or in any other way, for doing so does not take us from one inhabited land to any other. Glance at a globe and you will see that if you go straight from Australia or New Zealand to either South America or South Africa you do not cross the Antarctic, nor would you if you flew between South America and Africa. But in the northern hemisphere, if you draw on the globe the shortest distances between the great cities of the old and the new worlds, you will find many of the lines crossing the Arctic, and some running near its center. This is why there were important commercial deductions to be made from the Amundsen-Ellsworth flight in the Norge from Spitsbergen to Alaska. Also, the comparative ease and

certainty with which Byrd flew and navigated from Spitsbergen to the North Pole and back demonstrated the possibilities of Arctic air lanes. And Wilkins was a great pioneer in transportation when he not only flew across the full width of the Arctic from North America to Europe, but also reported that the flying conditions on that route were better than on any routes of the same length known to him either through his extensive flying experience in the tropics and the temperate zone or through his reading and the reports of travelers and scientists. For this meant that the shortest routes between great cities were also in many cases the easiest and safest.

The Antarctic continent, then, is so located that it will never be a thoroughfare. The Arctic Ocean is so located that, in view of its favorable conditions, it is



*Underwood & Underwood*

**THE N-25, OF THE AMUNDSEN-ELLSWORTH 1925 EXPEDITION**

The first attempt to reach either of the poles by the use of airplanes was made in 1925 by the expedition led by Roald Amundsen and Lincoln Ellsworth. Using two airplanes, the expedition ran into adverse winds and, having used up half their gasoline, they landed in order to determine their position. They had reached 87° 44' North Latitude, but they having landed in a lead, the ice closed in and the party was forced to remain for twenty-five days before managing to get away in the N-25 for the return flight





*Courtesy of the Amundsen-Ellsworth 1925 Expedition*

#### THE RETURN OF THE N-25

After having been given up for lost, the Amundsen-Ellsworth 1925 Expedition electrified the world by reappearing in Spitsbergen after an absence of twenty-five days. One plane had to be left behind on the Arctic ice, and only after the most grueling labors had the party been able to rescue the other plane and prepare a runway on the ice that would permit the machine to rise

bound to be covered within the next half century with a network of airways connecting the world's commercial centers. Dirigibles will fly at all seasons on straight routes, like ocean steamers, one of them completing the whole voyage. The airplanes will fly on routes less straight, for they will have to travel by relays as our railway locomotives and transcontinental air mails do now.

There is a similarity in the abundance and distribution of life in the seas of the north and south, but a contrast on the lands. As you proceed in the ocean either north or south from the equator, you discover more animals the farther you go, so that when you get to Alaska, Newfoundland, Norway, or Spitsbergen in the northern hemisphere you find incredible quantities of herring, cod, seals, and whales. Such life increases even faster as you go south, or at least it is more abundant at the edges of the Antarctic

than anywhere else in the world, so far as we know. This greater southern abundance is very probably only the result of two main facts: that there are more square miles of ocean than in the north, and that man, the great beast of prey, has not as yet devastated the southern ocean as he has the northern.

But in the south the margin of the land is the boundary of animal life. The seals and the penguins do crawl a few hundred yards from the water occasionally, and they cannot go farther. Beyond that there is only a little plant life. Two flowering plants have been found in the Antarctic and a few score of the non-flowering mosses and lichens.

In the Arctic, too, the seals and many of the sea birds are confined to the beaches, but some of the sea birds, such as the gulls, go far inland. Then there are in the Arctic not two flowering plants but several hundred, besides several hundred





*Copyright by Underwood & Underwood*

**THE ANTARCTIC CONTINENT PROBABLY OFFERS SCENES LIKE THIS**

Although this photograph was taken from an airplane flying over the rough land around Spitsbergen, it probably shows a scene not greatly different from many that Byrd and Wilkins will find in the far south



*Wide World Photos*

**BYRD'S PLANE ASHORE IN SPITSBERGEN**

Just prior to his flight to the North Pole. Within a few hours after Byrd's return, Amundsen and Ellsworth, this time in the dirigible Norge, left Spitsbergen and made the first crossing of the Arctic Ocean



*Courtesy of the Amundsen-Ellsworth 1925 Expedition*

#### A VIEW OF THE NORTH POLAR ICE

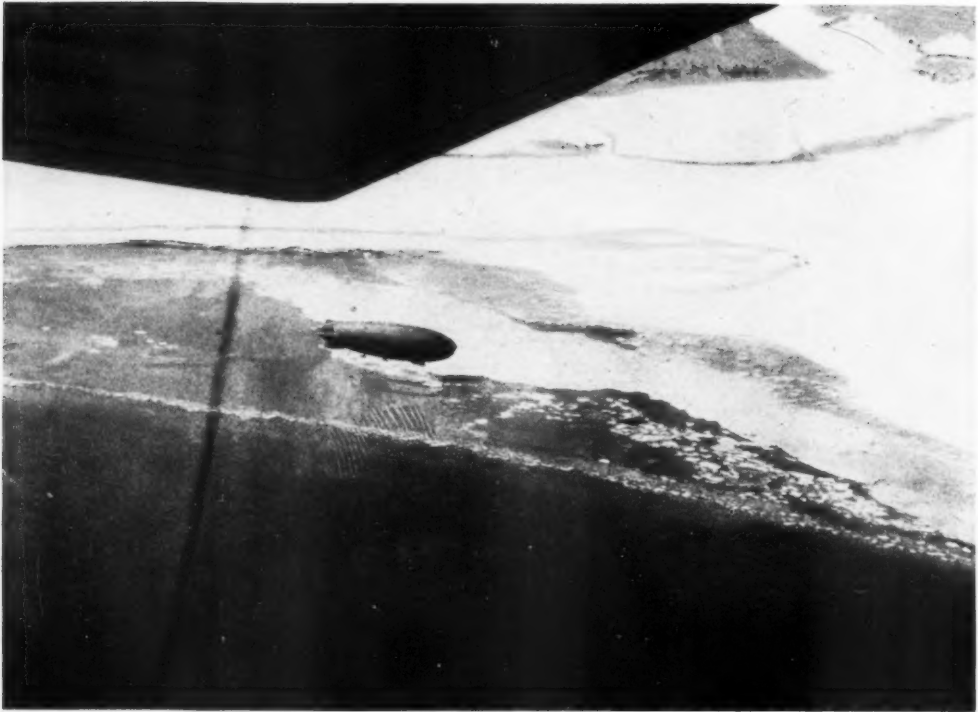
Undoubtedly the problems to be solved by the aviator bent on reaching the South Pole are even greater than those that have to be overcome in the north. Many difficulties lie in the aviator's way in the north, but great altitude is not one of them



*"International Newsreel"*

#### THE PLANE IN WHICH WILKINS CROSSED THE POLAR SEA

Because Amundsen and Ellsworth, in the Norge, had flown from Spitsbergen to Alaska over the Pole, Wilkins flew a different route between Alaska and Spitsbergen. Neither located any new land in the Arctic Ocean



*Courtesy Amundsen-Ellsworth 1926 Expedition (N. Y. Times Photos)*

#### THE NORGE LEAVES SPITSBERGEN

This photograph of the Amundsen-Ellsworth dirigible, taken from Commander Byrd's plane by Russell D. Owen, shows the start of the first successful flight across the Arctic Ocean

species of mosses and lichens, and more than a score of ferns. It was formerly thought that mosses and lichens were the chief vegetation of the Arctic, but we now know that in tonnage flowering plants are at least ten times more abundant there and probably a hundred times. They are found not only on the north coasts of the continents but also on the north coasts of the remotest islands that are far beyond the continents. Forests of spruce and other trees go well inside the Arctic circle, even where there is no Gulf Stream or other warm ocean current to help them.

Because the plants are numerous, the insects, birds, and quadrupeds that live on them are numerous in the Arctic, too. Peary met a bumble bee half a mile north of the most northerly land in the world. DeLong met a butterfly twenty miles away from the nearest island when he was more than 700 miles north of the

Arctic circle. Both the caribou (reindeer) and the ovibos (musk ox) have been found grazing on the most northerly islands. They do not migrate, and are as prosperous there in mid winter as in mid summer—in fact more prosperous, to judge by how fat they are at different seasons. There are more than 150 species of birds that go to the Arctic every summer to breed, and the individual birds are there by the million. Some of the birds, too, spend the whole year—a few ravens, a few owls, and thousands of ptarmigan. A caribou herd that moved past my Arctic camp in 1910 must have counted several hundred thousand, probably more than a million. It took them four days to march by and the column was four miles wide.

In contrast to this, the Antarctic has no land mammal at all. If there is any vegetation far from the coast it is only a rare lichen or moss on a projecting rock;

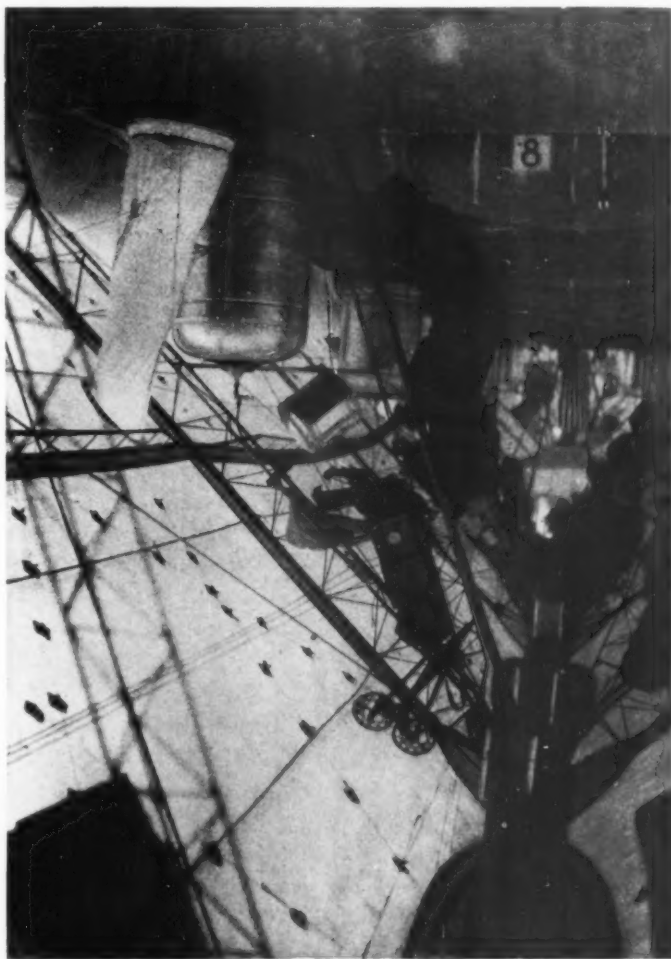
perhaps, beyond them, may be found some bacteria or similar plant growing in the snow.

The human adventure of discovery, controlled by natural forces, has been fundamentally different in the north and south. There was a time when everybody believed that the Arctic was as snow covered and lifeless as the Antarctic really is, but theories change as knowledge grows and practise adapts itself to them. The earlier post-Columbian explorers of the Arctic thought that they could work only in summer and would have to flee home before autumn. Those who were caught by the winter ice expected to die, and most of them did die. These men were really frightened to death, in the sense that their fear of the Arctic destroyed their competence. Some more literally died of fright, for gloom and dread spoil digestion and ruin health.

When it gradually appeared that this extreme dread of the North was auto-suggestion, the theory and practise grew to be that journeys afoot could be made in spring and fall, with the explorers hibernating through the winter. That condition held till the middle of the last century when McClintock and some other Englishmen broke away from it during the Franklin search, beginning to travel in March, which in the Arctic is as cold as any month of the year.

It remained for Peary to finally overthrow the dread of the Arctic winter and to teach men to fear instead the effects of the summer heat. He eventually laid it down as a principle that successful sledge exploration over the Arctic sea must begin in February or March, and should end in April or early May. This plan led to safety, to success, and even to comfort, in the last work of discovery that had to be done on ice that was afloat and constantly drifting back and forth upon the Arctic Sea.

The Antarctic is really as icy and life-



*Courtesy Amundsen-Ellsworth 1926 Expedition (N. Y. Times Photos)*  
IN THE RIGGING OF THE NORGE

The equipment included tents, sleeping bags, skis, snowshoes, rifles, shotguns, ammunition, a hand-sledge, and a big canvas boat



#### ARCTIC AIR LANES

The Arctic Ocean, entirely surrounded, as it is, by land, will undoubtedly some day be crossed by air lanes leading between the important centers of Europe, Asia, and North America. The shortest routes from New York or Chicago to any Asiatic city of consequence lead across the Arctic, and many other routes do the same

less as the theorists formerly supposed the Arctic to be. There is really an ice cap too, such as was formerly supposed to cover the Arctic. Therefore the travel methods that used to be considered suitable for the Arctic are really suitable for the Antarctic. Whether you are going to sledge or fly, your work in the South begins in spring, extends through summer, and ends in the fall.

In the Arctic, darkness does not interfere with flying as such in midwinter, but it does interfere with exploration; for there is not much use flying over a place unless you can see pretty clearly everything within your horizon. The exploring season is therefore short . . . say from the middle of February to the beginning of May . . . and during the first half of it you are somewhat handicapped by darkness. Moreover, you are flying in the early part of your season at the lowest

winter temperatures. In the Antarctic, with seven months of clear daylight available, you do not begin until the lowest cold of winter has passed, and although the midwinter temperature of any given place is at least  $30^{\circ}$  lower in the South than in the North, still the northern flyers, like the northern sledgers, will continue to do their work at temperatures averaging at least  $30^{\circ}$  colder than those of the Antarctic.

As to storminess, there are both similarities and differences between the North and the South. The underlying similarity is that storms in both places are violent and frequent only where there is high land fronting on open sea. This means, however, that storms are frequent and violent along most of the coast line of the Antarctic continent, but only in rare places in the Arctic. Taken as a whole, the Arctic has the least storms for an area



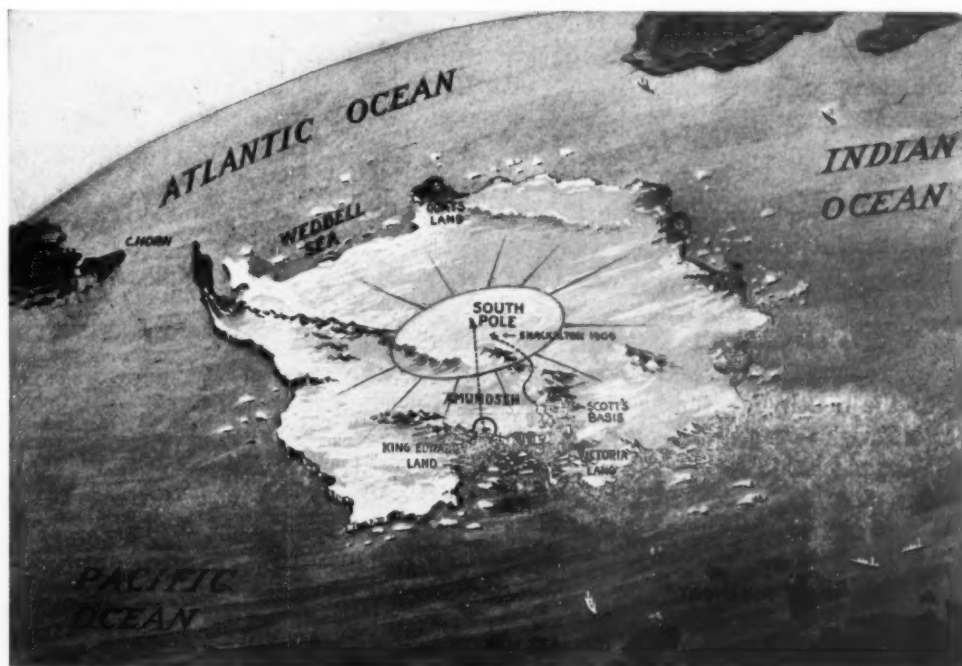
of that size in the northern hemisphere, winds both fewer and less violent. The Antarctic land margin, on the other hand, is the stormiest region of the whole world.

It follows from what we have just said that as you proceed toward the center of either Arctic or Antarctic the winds become fewer. However, there is no completely windless spot in the Arctic; but it seems probable that there is an area of a great many thousand square miles in the Antarctic where no strong wind ever blows. At least Amundsen came to the conclusion that no considerable winds ever blew right at the mathematical south pole.

It appears, then, that the work planned by Wilkins for the Antarctic is as dangerous as it is scientifically important. Nothing concerns geographers so much down there as to determine the coast lines and therefore the extent of the continent. If

Wilkins carries out his projected flight of more than 2000 miles along the continental edge, he will fill up the biggest gap there is in our Antarctic geographical knowledge.

Wilkins has a theory that while all the other margins of the Antarctic continent are high, the unknown coast he wants to explore is likely to be low. Solving this problem is of great interest to geographers, and of perhaps even more importance to meteorologists. For if this be a low coast, then the violent winds found on all the other sides of the continent may be absent here, as the known storms are supposed to be caused in large part by the mere gravitational flow of heavy cold air down grade towards the sea. If the coast proves to be high, there will be violent storms at right angles to his course blowing him straight out to sea, and if he ever comes down in the water or on the loose ice,



#### THE ANTARCTIC

The Antarctic differs in many ways from the Arctic. Where the North Pole lies in the center of a deep ocean, the South Pole lies in the heart of an ice-covered continent. Where the Arctic Ocean lies along the shortest routes between many important centers of population, the Antarctic Continent does not. The shortest routes between the tips of Africa, South America, and Australia all miss the South Polar land mass

there is no further hope. For (if the coast is steep) there will be heavy seas running on the water and the cakes of ice will all be floating rapidly seaward. This direction of ice movement is one more fundamental difference between the North and the South. Every cake that once gets adrift from its Antarctic moorings will float steadily away till it melts in the warming sea; but in the Arctic most cakes that float away from one land are only floating towards some other. The peril of drifting into the open sea, found everywhere in the Antarctic, is found in the Arctic only near Spitsbergen.

But while the scientific problems that hinge on the Byrd plans do not thrill the geographers and meteorologists quite so much, his plan is the better of the two, and more sensible, in that it is safer, for he intends to fly straight inland. If he can find a good base on the coast and then start during a calm, he knows that any wind that strikes him within the first few hundred miles is bound to be a direct head wind, so that if it proves too violent to stem, he can always turn about and use it as a tail wind to carry him home, whence he can make a second start. Moreover, the calm he chooses to fly in will probably last several hours, if not days, so that he will get beyond the coastal belt of violent storms before he has any opposition. If he then wants to fly to the South Pole, as he did to the North Pole, he can count not only on calm weather, at least from the half way point to that destination and back again half way, but can also be sure that if after he passes the half way point on his return there is a strong wind, then it will be one that carries him towards home. On the other hand, if he decides after reaching the South Pole to continue across the continent to the opposite coast, then he knows that any wind he runs into will be a fair wind and that the only danger in it will be that it may make safe landing difficult

where the flight should end near the sea.

Flying the Arctic has a transportation significance which flying the Antarctic cannot at present be seen to have. In that respect, the southern work is in the field of pure rather than applied science. But it is not to be condemned for that reason, at least by nations that spend millions a year on the study of nebulae that are more remote and have less prospect of commercial development than even the center of the Antarctic continent.

But there are commercial aspects to the southern plans. The three chief lands radiating from the Antarctic . . . Africa, South America, and Australia . . . have vast grain fields that are cultivated on a bare margin of rainfall, so that a small decrease in the expected rain means poverty to thousands of farmers and even, in some cases, national distress. There are flocks grazing, too, in all these countries, on plains that burn up if the weather is too dry so that the beasts die by thousands. If only these countries knew a year or a few months in advance how dry the weather was going to be, they could control their planting, and they could ship and sell their animals while they were fat. There is a prospect that some day the science of meteorology will be able to foretell lean years. But, in the southern hemisphere at least, this development cannot be thought possible without a full understanding of weather conditions in the Antarctic.

The chief "practical" angle of the Byrd and Wilkins expeditions is, therefore, the direct contributions they may be able to make to meteorological knowledge, and more especially the advice they may be able to give when they return as to where and how permanent radio weather observatories can be established that will furnish such constant and systematic reports as shall finally enable us to predict the comings and goings of wet and dry seasons in the South Temperate Zone.

# THE CROCKER LAND EXPEDITION

The Story of the Last Extensive Dog-Sledge Expedition in the Arctic. The Final Effort in Three Hundred Years of Dependence on Brawn and Sinew Among the Ice Floes of the Frozen North

BY FITZHUGH GREEN

*The Crocker Land Expedition was organized under the auspices of the American Museum of Natural History, in New York, and the American Geographical Society. Contributors of funds and equipment to the expedition included Yale, Harvard, Bowdoin, and Illinois universities, and the Federal Government. It left New York in June, 1913, and after basing four years at Etah, North Greenland, returned in the autumn of 1917.*

*The purpose of the expedition was to solve the last great geographical problem of the north: Is there in the Polar Sea a large body of land still undiscovered? Geographers had produced evidence contrary to this supposition. Oceanographers and tidal experts upheld it. In 1906 Admiral Peary reported he had seen new land some hundreds of miles west of Cape Columbia. He named it Crocker Land after one of his backers, and the expedition hereinafter described had as its chief aim the verification of this report.*

*The objects of the expedition were scientific in character and may be briefly summarized as:*

(a). *Actually visiting, reconnoitering, and mapping Crocker Land or the sea ice at or about its supposed vicinity.*

(b). *Scientific exploration of the region between Flagler Bay and Cape Thomas Hubbard and of the Ellsemere Land interior.*

(c). *The attainment of the Greenland Ice Cap east of Cape York.*

(d). *The collecting of data and specimens along all scientific lines as far as practicable, including ethnology, geology, botany, seismology, ornithology, geophysics, terrestrial magnetism, meteorology, oceanography, and chemistry.*

(e). *Coöperation with the U. S. Weather Bureau for practical as well as research purposes, through wireless connection with a Canadian station which was to have been erected in the Hudson Bay district the summer the expedition sailed.*

*The scientific staff was as follows:*

*Donald B. MacMillan, A.B., A.M., leader and ethnologist.*

*Fitzhugh Green, M.S., U.S. N., engineer and physicist.*

*W. E. Ekblaw, A.B., D.Sc., geologist and botanist.*

*M. C. Tanquary, A.B., A.M., Ph.D., zoologist and biologist.*

*Harrison J. Hunt, A.B., M.D., bacteriologist and surgeon.*

*Jerome Lee Allen, chief electrician, received orders from the Navy Department to join in New York, and Jonathan Small was engaged at Battle Harbor, Labrador, as cook and mechanic.*

*The chief success of the expedition came in 1914 when MacMillan and Fitzhugh Green sledged across Ellsemere Land and out over the Polar Sea, emerging upon unexplored area, but failing to discover Crocker Land at or near its supposed location. Peary's cairns and records were picked up at Cape Thomas Hubbard.*

*During succeeding years sledge journeys were continued westward across Ellsemere Land and through known areas to the south and west of Axel Heiberg Island, as far as King Christian Land.*

*The sealer NEPTUNE, under command of Captain Robert A. Bartlett, brought the last of the party back in September, 1917. Unless otherwise noted, the photographs in this article are by Donald B. MacMillan—THE EDITORS.*

ARCTIC exploration now belongs to the airplane. The dog sledge is in a class with the prairie schooner.

Hence, our Crocker Land expedition to Greenland and the Polar Sea, 1913-1917, the last extensive dog-sledge effort in the north, marked the end of one of the

romantic periods of human enterprise. Further, as this expedition was in a technical way the culmination of all past arctic experience, its human interest was unusual, aside from its scientific activities.

Our plan really got its start in June, 1906, when Peary scanned the northern horizon of the Polar Sea while standing at Cape



THE "ERIK" ANCHORED AT ETAH, NORTH GREENLAND

The "Erik" was a fifty-year-old ship that was chartered after the "Diana," which had originally been chosen, ran ashore on Barge Point, in the Strait of Belle Isle

Thomas Hubbard, the northern extremity of Axel Heiberg Land, which he had reached from his base near Cape Sheridan to the east. Later he wrote: "*The clear day greatly favored my work in making a round of angles; and with glasses I could make out apparently a little more distinctly in the northwest above the ice horizon the snowclad summits of a distant land.*" He named his discovery Crocker Land.

Geologists politely controverted this report. Experiment had proved that when a sphere of viscous matter is revolved it tends to assume the form of a tetrahedron with the axis of revolution through one apex and the center of one plane.

Peary's soundings near the North Pole gave a depth of 1500 fathoms, while Scott and Amundsen found the elevation of the South Pole to be eleven thousand feet. This bore out the theory that the South

Pole was at the apex of the tetrahedral and the North Pole at the center of the fourth tetrahedral surface; it further implied that the whole polar basin was fairly flat and covered by the sea. By this reasoning new land was unlikely.

The other side of the argument was supported by many reports that land had been seen north of Alaska, and by tidal analyses by Dr. R. A. Harris of the Coast and Geodetic Survey which showed that currents crossing the top of the world indicated a Crocker Land.

At this writing, Amundsen and Wilkins have both flown over portions of the unexplored area of the Polar Sea above the American continent. Without finding new land they have narrowed down the million or so square miles that had never been seen by human eye when MacMillan and I went out by dog team. But there still are large spaces left to be checked up.



Happily, we shall soon know the full truth as a result of the industry of our modern air explorers.

We gathered in New York toward the end of June, 1913. On our small and old-fashioned expedition only seven men were taken. The horrors of past expeditions when scores perished in a single arctic night had proved the danger of a large personnel. The *Diana*, a 400-ton sealing vessel out of St. Johns, had arrived from the north. After ten days' loading we set sail for the Greenland coast. The *Diana* was wrecked on the Labrador. But we were able to secure another sealer, the *Erik*, from St. Johns, and again set forth northwards.

At about 75° N. the Greenland coast swings to the west forming huge Melville Bay which terminates in Cape York. Ellesmere Land opposite trends east. Together the two coasts form a long flask of which the neck is Smith Sound and the

flask Kane Basin. The latter connects with the Polar Sea through Kennedy Channel about 20 miles wide and twice as long. Polar ice and glacial bergs pour down into Kane Basin and choke the northern entrance to Smith Sound. But the earth's revolutions, combined with a northerly tidal set, crowd ice along west Greenland shores until the current is deflected by Melville Bay and again by Wostenholme Sound, where the crashing, grinding masses are carried across and down the western side of Baffin Bay.

In early August we established our base at Etah, the northern limit of the little tribe of Eskimos living thereabouts, and on the east side of the bottle-neck just described.

The little tribe with whom we intended to live belonged to the unspoiled type. Early British expeditions reported these natives savage and treacherous. It is possible that this was assumed after several



A SLEDGE ON THE ROUGH ICE OF THE POLAR SEA

Over such ice as this only the slowest progress can be made. After a heart-breaking day's labor one is likely to have made very little headway, and that only by risking serious damage to sledges and dogs





#### A POLAR BEAR ON A BERG AT ETAH

These handsome animals are perfectly at home on the ice or in the icy water, and are to be found, occasionally, far out on the ice of the Polar Sea



#### LITTLE AUKS

Bird life in the Arctic is variegated and far from rare. Little auks arrive in North Greenland from the south about the middle of May, and leave for the south again in August



*Photograph by E. O. Hovey*

#### **BORUP LODGE**

The headquarters of the Crocker Land Expedition at Etah. Here, on the shore of Foulke Fiord, within 700 miles of the North Pole, this structure was erected



#### **SUMMER ON THE SHORE OF ALIDA LAKE**

Hunt, Green, and Allen, of the Crocker Land Expedition, with a group of Eskimos near Brother John Glacier which marks the end of Alida Lake, the uppermost portion of the fiord at Etah



#### DIFFICULTIES OF NAVIGATING FOULKE FIORD

The electrical and wireless equipment of the expedition was transferred from Etah to Starr Island with the aid of the motor boat and one whale boat. Starr Island was about two miles from the headquarters at Borup Lodge

centuries' experience with the North American Indian; and an Eskimo is inclined to do as he is done by. Peary, however, gained their confidence and fairly won their friendship and admiration. They speak of him as "the white man who never lied"; as "the one who was always ready to work in the morning"; and as "he (the white man) who dares come back." He found them childlike and often unreliable, but usually honest and loyal, and capable of work and hardship to an incredible extent. Endless generations of the fight they wage for existence have made them almost perfect in the art of arctic travel. Peary cleverly recognized their value as assistants, thereby outdoing his predecessors until he finally reached the Pole.

By October we were pretty well settled so far as living quarters were concerned. The little shack we had built on the beach

was a great success. From the Eskimos we learned what winds to expect, and frequent northeast gales proved their information correct.

At MacMillan's suggestion each white man formed particular friendships among the visitors, in order that those of us who should travel might live for a time in native style and assimilate so far as possible the habits and tricks of Eskimo life. Our system involved a deliberate descent to primitive existence for the purpose of mastering such arts as dog driving and building snow houses.

Sipsu took my fancy from the start. He was stocky and lithe, reserved but alert, and clever beyond many of them older than himself. Four children, a wife and a mother-in-law depended for their living upon his skill with harpoon and lance. He taught me to build a snow house and start a native lamp with moss and

blubber. He explained how one must trail and meet a bear, first in his autumnal satiety, and last in the fierce bloodthirstiness of his spring famine. By watching Sipsu I came to understand the care of my feet—vastly important in the bitter nights and the long marches. I observed his dog discipline, and practiced my whip stroke in imitation of his own. Detail by detail I mastered the unwritten lessons which every Eskimo boy must learn before he dares go abroad amid the treacheries of cold and wind and darkness.

Each white man took his course. It was not easy; rotten meat and vermin could not go easily with ten centuries of culture. We stuck it out, though, and thereby bought our lives, as later experience showed us. By December four of our party were fit to take the trail for serious work.

Our garments were entirely native except the single suit of woollen under-

wear. We found the Eskimo costume remarkable for three qualities: lightness, warmth and durability. My whole outfit in which I was able to travel and, by tightening a few strings, to sleep without a bag at 60° below zero Fahrenheit, weighed no more than did my naval uniform overcoat. Boots were of sealskin, hair scraped off and paper thin, loose fitting, with heel and toe thongs like a snowshoe. A drawstring at the knee kept snow out. Stockings from the arctic hare were soft as down. Between the soles of boot and stocking was placed a thin insulating layer of dried grass. This was changed every night on the march in order to prolong the period allotted to each set of footgear before drying was necessary.

By Christmas a ton of depoted provisions were out. As much more fresh meat was in from the south, and skins sufficient for full outfit had been procured. Our Christmas party had been advertised



*Photograph by Fitzhugh Green*

COMMANDER MACMILLAN, THE LEADER OF THE EXPEDITION

Taking an observation on the Polar Sea in order to determine the position of the party



#### DIFFICULT SLEDGE WORK NORTH OF ETAH

This hill, near Anoritok, lies between Etah and the Humboldt Glacier, in a district occasionally visited by the native Eskimos



#### A CAMP ON EIDER DUCK ISLAND

On one occasion 4000 eider duck eggs were gathered near this camp in order to supply the needs of the expedition





#### A STEEP HILL NEAR ETAH

In order to travel from the fiord inland, it was necessary first to scramble up this hill, before the less abrupt section of the trail was reached



*Photograph by Fitzhugh Green*

#### A VIEW FROM STARR ISLAND

Where the electrical equipment of the expedition was installed after having been transferred from Etah

some weeks previously in order to attract the men we expected to have make up our sledge caravan. We taught them the use of tools, which they learned with remarkable speed. A score of sledges were built. Solid oak sides and soft pine cross-bars were furnished to the natives which they lashed and finished to suit themselves. Thongs took the place of nails in this work, and no sailor or rigger in the world could do better than these unskilled savages whose vise-like teeth and strong short fingers are their only tools outside a long knife. Bow drills were little used. Holes for lashings were gouged with a sharp pointed blade, or on cold days shot through with a rifle. By New Year's day the gaunt skeletons of eighteen sledges leaned against our roof.

January came with even more bitter cold, but days soon grew brighter as the sun approached our latitude. February 7

was set for the departure of the first party towards the Polar Sea.

On this first start we reached the mouth of Flagler Fiord about 100 miles from headquarters. Two Eskimos came down with mumps and several dogs died. The weather was bitterly cold. MacMillan decided to go back and reorganize.

On March 11 we made a second start. The weather was cold but a low sun in the south lent a new brilliance to the white snow fields and deepened the blue of the glaciers. Tanquary had frozen both of his feet in February, and Dr. Hunt's services were required at Etah. MacMillan, Ekblaw and I, and eight Eskimos, formed the new party. With empty sledges and large teams we sped across Smith Sound and down Hayes Fiord, reaching the scene of our recent failure in two marches. Here already were two tons of provisions, more than we needed for the reduced



JEROME L. ALLEN, WITH HIS DOG TEAM

The hardy dogs that supplied the motive power for the expedition's sledges were sometimes used during the short summers as well

*Photograph by E. O. Hovey*

#### ESKIMOS STARTING ON A MARCH

Upon the Eskimos of the vicinity of Etah the expedition was forced largely to depend, and several of them proved very useful during the four years the expedition spent in the North

number of sledges, or at least more than we could carry.

At the head of Beistadt Fiord we were confronted by the Ellesmere Land Glacier which flows in at this point. The problem which confronted us quickly put a stop to dreaming. Our party of 11 men and 100 dogs, together with about 6000 pounds of food and other equipment, faced a perpendicular wall of polished ice two miles wide and flanked by unscalable cliffs. At a point 40 feet above us the icy buttress sloped back slightly, and at 600 feet up, rounded into the main glacial body which mounted at an angle of  $30^{\circ}$  to the ice-cap shimmering against a pale sky. We could well imagine cutting steps in the steely ice, but 48 hours at the most was all we dared spare for the job. We drank our evening tea a little despondently.

All told, in three days we crossed 40 miles, 5000 feet altitude, and a million

crevasses, into which we stumbled and dragged ourselves out until fear lost its thrill. We lost our way. We were forced to repeat the ice cutting in order to descend. As near as we could judge we had reached Bay Fiord which Sverdrup had marked when he came up this side and spoke of the impenetrable interior, which we had just crossed.

Then, as is the way with arctic work, plans fell to pieces. Ekblaw disclosed a frozen foot. We had hoped for game; none appeared. We discovered our supplies could not now last beyond Cape Thomas Hubbard; and the extra fuel used on the ice-cap had been in excess of our safe limit. Two hundred miles from the Polar Sea we again faced failure.

On the following day Ekblaw and I with four Eskimos started back over the Glacier. Two Eskimos and I picked up supplies at the main base on the east side



FOULKE FIORD IN SUMMER

Etah is situated on this inlet from Smith Sound, and although it is often called the northernmost settlement in the world, it is hardly a permanent city, for it is made up of only five caves in a sloping hillside, which sometimes are inhabited and sometimes are not

and started west again to overtake MacMillan. After a chase of nearly 300 miles, mostly through smothering drift, I caught him at Cape Thomas Hubbard on the shores of the Polar Sea on April 13th.

On April 15 we headed out over the Polar Sea. Regular observations for latitude checked our dead reckoning. About this time a faint shadow in the northwestern horizon fired us with visions of success. The Eskimos shook their heads. "*Poursuaq*," they said—"It's just mirage." And so it seemed, for with all the speed of our pursuit, the specter grew no nearer.

Peary placed Crocker Land 130 miles out. At 105 miles we cached most of our food and ran for it. Two marches more placed us beyond the 150 mile mark. The day was perfect, crystal clear horizon, and no wind. We climbed the highest berg and saw nothing. Disappointment is a hard lot after real effort. We swallowed ours, together with a half ration of pemmican, and returned heavy hearted to our impoverished teams.

With empty sledges we double-marched

back to land. Twice we were caught in the jaws of grinding crashing pressure. Several narrow escapes on the rubber ice of leads were scarcely noticed in our swift race to safety. Four hours' sleep, forty miles' hike, four biscuit, and a bit of meat, was our program.

We reached the foreshore off the cape with feelings of mixed relief and sadness. Peary's cairn was visible several miles out and had been our guiding beacon above the low seud of ground drift. We climbed to the summit and secured the record, replacing it by a copy and short account of our expedition to date. And we, too, as did our great predecessor, scanned the northern horizon where seamed reflections of ranges of broken ice beckoned in luring falsity. So like land was the phenomenon that, had we not been out, we, too, should have announced its discovery and urged its exploration.

To our west lay a stretch of coast as yet untrod by man. MacMillan magnanimously gave me this opportunity for real discovery and exploration. All the adventurous blood in my veins boiled up at

the prospect. Next morning we separated, he with Etukeshuk towards land in the east, and I with Peewahtoq down the unknown shores in the southwest. The balance of the trip, though long, was without noteworthy event.

May 20 was a red-letter day. Uvd-loriark and Acpuddyshao met us at Pim Island. A note from Etah reported all well. Finally a box of jam and canned fruit with plenty of biscuit and tinned meat completed the joy of our return. The dogs were not forgotten. A fine, fat, rotten hunk of walrus meat was apportioned among the teams, who immediately outdid all former records in the violence of their ensuing riots.

Next morning we reached Etah. That home-coming was enough to inspire poetry in the breast of a stone wall. It surpassed the bliss of heaven, marriage, or a raise in pay. In three months we had traveled 1300 miles on pemmican, tea, and biscuit.

Remorseless routine of work and sleep, plod-plod-plod, with a tiny ration night and morning, had chained us like some terrible sentence which in the end must have consumed our aching bodies as they strove so painfully to keep going.

The chief geographical task was now finished. In the second year Ekblaw made a traverse of Ellsemere Land up through Greeley Fiord which had never been entered before.

As Rasmussen unexpectedly announced his arrival in the Smith Sound district and his plans to go to Pearyland, this project was called off. Starvation among the Eskimos and many deaths among the dogs curtailed the other work.

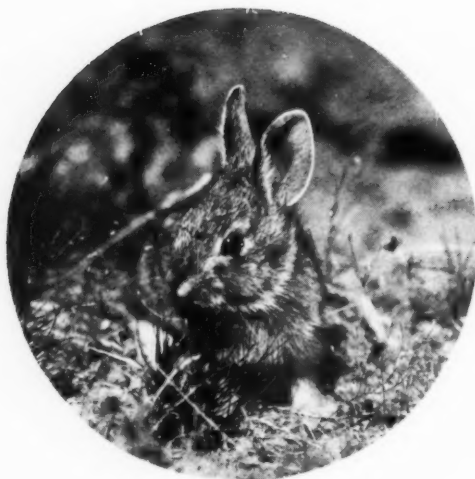
In 1916 MacMillan and several Eskimos traveled west across Ellsemere Land to Findlay Island. The following year Capt. Bob Bartlett in the "Neptune" traveled north and picked up the party and its collections.



TWO ESKIMO KYAKS AT ETAH

These tiny skin boats are universally used among the Eskimos when there is any open water. When not in use they are often laid up out of reach of the always ravenous dogs, which otherwise might be tempted to feast on the skin coverings





BABY COTTONTAIL  
The big game of the  
Eastern school boy

Photograph by  
H. E. Anthony

## BR'ER RABBIT'S WIDESPREAD FAMILY

The Numerous Rabbits and Hares That Dwell in Swamp and Thicket, on Plain and Desert and Mountain from Tierra del Fuego to the Mouth of the Mackenzie and from the Atlantic to the Pacific

By ROBERT T. HATT

Assistant Curator of Mammals, American Museum

With ten drawings by Francis B. Shields

**I**f yo' all has bad luck yo' jess ketch a rabbit by a grave yahd in de dahk of de moon an keep his leff hin' foot about. Calamity woan follah yo' no moah den."

So I was assured near New Orleans. After I crossed to New Mexico, the information was imparted to me that any dead rabbit was good luck, but that a live rabbit was a scourge and a pestilence that consumed the life-giving grass which should go all to beef. And the rancher is not without some just grievance, though it is his cattle that have encroached on the jack rabbit's domain, and not the hare on his.

Within the borders of our continent live more rabbits, conies, and hares than in any other. The vast total of individuals is not surpassed and our number of species is above rivalry. In North America alone, science has recognized 143 forms. These

creatures dwell from the water's edge of the Atlantic to the wet sand along the Pacific shore; from Patagonia to north Greenland; from the floor of Death Valley to the rock wastes above timberline on our highest peaks.

Greatest of all this host are the hares. In contrast to the rabbits they almost never frequent burrows. Their young are born out in the open, furred and open-eyed, ready to follow their mother when danger threatens. Our rabbits, on the other hand, often make small dens or occupy deserted homes of larger game. In this shelter live the young during their first days in open air, furless, blind, and helpless. High above the homes of these live the final family of this, our leporid trinity, the pikas. With ears almost as short as fur, and innocent of tail, with leapless legs, they live their lives among the rocks that shelter them. No doubt be-

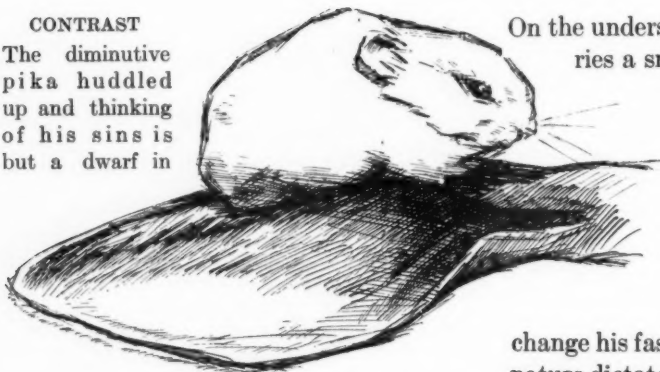


#### PIKA

These tiny rabbits of the mountain rocks sit for hours sunning, calling back and forth among themselves and at intruders, yet they have heeded Æsop and busy themselves in summer making hay for winter use

## CONTRAST

The diminutive pika huddled up and thinking of his sins is but a dwarf in



contrast to the antelope Jack rabbit whose ear is larger than the body of a pika

cause they took up vulgar whistling their relatives banished them to these broken wastes, where they live almost alone. In spite of their multitudinous peculiarities they look for all the world like rabbits and inwardly show themselves as such.

In size the Lagomorphs range from the fifteen-pound hare of Greenland to the diminutive five-ounce pika who is so abbreviated that, if opportunity offered, he could stand upon the ear of a lanky Arizona jack rabbit.

The group has not gone far in brilliant coloration. The backgrounds against which rabbits most appear give the key to their hue, and this key is followed modestly. Living in desolate snowy wastes, the polar hare has taken on a coat completely white but for the smallest group of jet black hairs which tip his ears and furnish marks of recognition. In the dull brush of the temperate States, familiar Molly Cottontail has adopted brown and finds hiding simplified.

## POLAR HARES

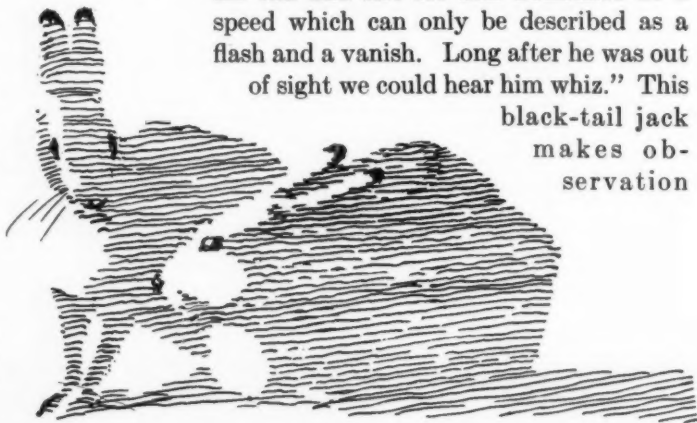
Were their ear-tips, noses, and shadows not black, the polar hares would be invisible against a snowbank

On the underside of her tail alone she carries a snow-white powder puff that those of her sorority may know her. The snowshoe hare confronts a more perplexing problem. In summer he lives in the swamps and woods; in the winter on the snow.

Twice a year he must change his fashion and don clothing which nature dictates inconspicuous. The desert hares, or jack rabbits as they are called, assume the pallid hue that their surroundings bear, keeping only the personal touch of black ear tips and a black shield on their tail. One species only disobeys the laws, for there is none to impose the penalty on this vagrant. *Espirito Santo* is a light-hued desert island in the gulf of Lower California, and here lives this hare that is as nearly black as he can be, no less conspicuous than a white swan upon a well clipped lawn. But enemies are few or none, so the hare does as he pleases, proudly hopping about in sable beneath a tropic sun.

What have we among the hares? A host of jack rabbits whose home is on the plains and deserts, where they can give fullest play to their fine legs and sensitive, rain-shedding ears. Mark Twain first made them famous when he said of one in *Roughing It*, "He dropped his ears, set up his tail and left for San Francisco at a speed which can only be described as a flash and a vanish. Long after he was out of sight we could hear him whiz."

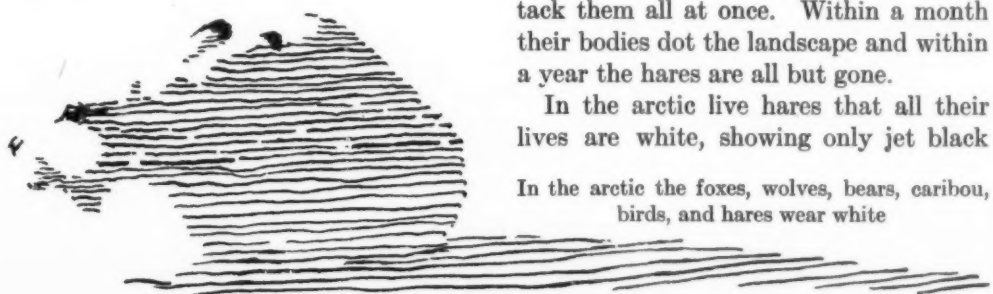
This black-tail jack makes observation



leaps four feet into the air, the better to see what his pursuer does; while on the straightaway he leaves ten times his length of earth untouched.

Few things vegetable are shunned by desert hares. Even the spiniest cactus is quickly reduced, if but a small part of its surface is freed of thorns to allow an opening nibble. The rest becomes then easy demolition. The creosote bush is always shunned, and flesh is never taken, but the menu is broad and has been much increased by man, so that where one hare lived a poor life on dry grass before, twenty now thrive on sweet alfalfa and juicy melons.

Living, as they do, amidst a vegetation that presents thorns and claws at every point, one would expect the jacks to be torn and scarred, with ears like storm-ripped banners. Yet the hare has learned the ways that he must go, and seldom is molested. Queer it is, but our barbed wire takes heavier toll than nature's does. On the contrary, the cactus in the hottest deserts is a hare's great blessing. By day one sees his gray form in the shadow of a spiny trunk, moving clockwise from the sun, to keep within the narrow shade. Heat to him is devastating, and he is not prone to run great distances at noon, but sits with drooping ears and dozing senses. A telegrapher from a lonely station in mid-Mojave said that when the crew of the midnight train threw off a cake of ice for him, the hares from all the desert round about drew in to lick the foreign apparition.



#### ATTENTION

Whistle sharply at a running cottontail and he will stop, sit down, and listen in wonder at your note

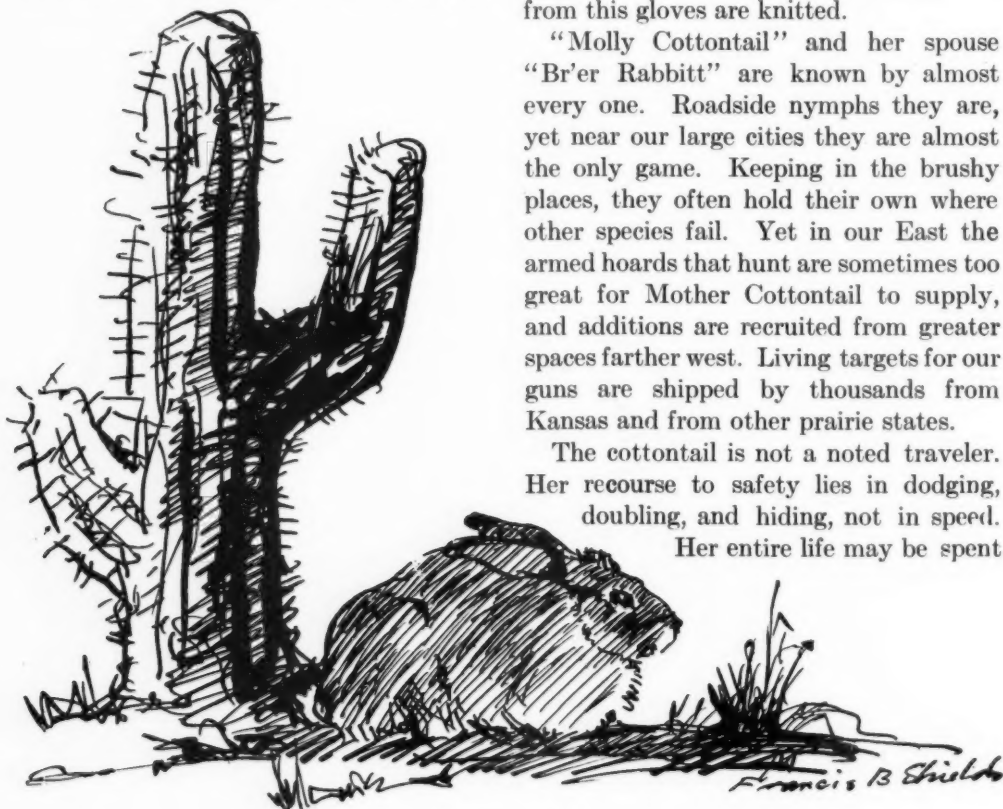


In forests and in heavy woodland brush lives a hare with shorter legs and shorter ears that, with the snow, dons a white coat and grows snowshoes on his feet. Then his brown hair of two months' past does not doom him, nor his slender feet of summer make him flounder in the drift when the fox pursues. His spreading toes, with fringe of hairs along them, support his weight when underfoot it is softest. The varying hare adorns our northern woodlands everywhere. More than that of others in his family, his fame is great for his inability to keep his population in control. Locally, about once in seven years, his kind fills the land to overflowing so that, in two hours' shooting, one man has taken fifty hares and could have increased this number. Hares are everywhere, and then their flocking enemies, famine working fast with undernourishment, parasites and plagues, attack them all at once. Within a month their bodies dot the landscape and within a year the hares are all but gone.

In the arctic live hares that all their lives are white, showing only jet black

In the arctic the foxes, wolves, bears, caribou, birds, and hares wear white

noses, and ear tips. The fur upon their soles lies to a depth of half an inch, like the soft deep pile of a thick carpet.



DESERT SHADE

The desert hares are not advocates of sunbaths and make the most of scanty shade.

Half hidden in this silenced foot lie claws that are unequalled in the southern species, claws that break the strong crust of the snow when others starve; aided by teeth that are protruding in this hare alone. In Greenland some explorers found the hares incapable of fear, and great droves scarcely kept beyond the reach of the infuriated harnessed dogs. From a man who acted gently toward them they readily accepted food and allowed themselves to be picked up and fondled time and time again. The arctic hares have on more than one occasion saved lost men from starvation. They are a staple diet with the nomads of the north, who

also cut the pelt into strips and weave these into priceless light warm blankets. Even the hair is made into thread and from this gloves are knitted.

"Molly Cottontail" and her spouse "Br'er Rabbitt" are known by almost every one. Roadside nymphs they are, yet near our large cities they are almost the only game. Keeping in the brushy places, they often hold their own where other species fail. Yet in our East the armed hoards that hunt are sometimes too great for Mother Cottontail to supply, and additions are recruited from greater spaces farther west. Living targets for our guns are shipped by thousands from Kansas and from other prairie states.

The cottontail is not a noted traveler. Her recourse to safety lies in dodging, doubling, and hiding, not in speed.

Her entire life may be spent

within an acre thicket. Yet in our times she has followed the plow the length of Michigan and into Ontario where before she was quite unknown.

The cottontail has two southern cousins that have taken up peculiar lives. Both have shed the strong dislike of their widespread relatives for water. These forms are known as the swamp rabbit and the marsh rabbit, the latter being the more aquatic of the two, while the "cane-cutter" of the swamp is twice the size of his better swimming neighbor. The swamp rabbit takes to water when pursued, but the marsh rabbit with spreading toes and short-haired feet may seek the water for

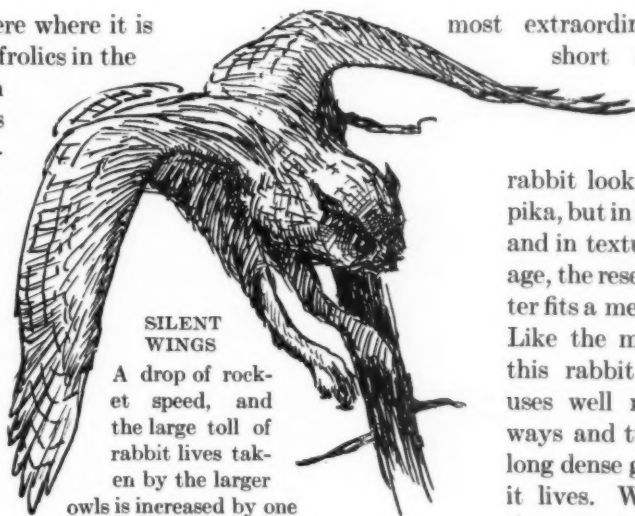


sport alone. There where it is eight feet deep he frolics in the moonlight. When a hunter frightens him he lies submerged among the lily pads with only eyes and tip of nose in air,—so confident in the efficacy of his concealment that it is said he sometimes lets himself be touched

before striking out for home in greatest haste.

In a small region which embraces corners of four states and within the haunts of jacks and cottontail, lives the tiniest rabbit of all, the pygmy, as he's named in books. Few know this rabbit, for his range and population are in proportion to his size, and of all our group he is the most private in his life. From early morn until sunset he hides within a burrow which he himself has dug, or in the abandoned doorway of a badger's home. When, near dark, he ventures forth, it is with stealth, keeping close to mother earth, and venturing none of the high hops of his cousins. If he is seen, it is by no wish of his. For a week I hunted him and then found that to get the pygmy, one had to shoot quickly from the hip or blindly into a bush into which one had seen a pygmy's shadow pass. But, when the limp form lay in the cup of my hands, the joy of hunting disappeared, and it seemed as though I held an elf, so perfectly was he a hare in miniature.

High on the slopes of Popocatepetl and Iztaccihuatl, overlooking the fertile Valley of Mexico, lives a creature that, though not taking the place of the smallest of our rabbits, truly is the



SILENT  
WINGS

A drop of rocket speed, and the large toll of rabbit lives taken by the larger owls is increased by one

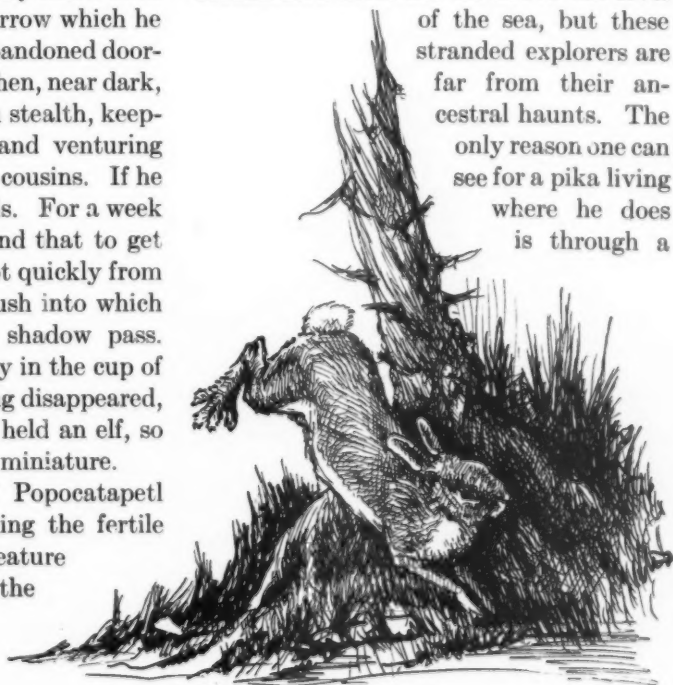
most extraordinary. With short round ears, and no tail at all, this

rabbit looks most like a pika, but in form, in color and in texture of its pelage, the resemblance better fits a meadow mouse. Like the meadow mice, this rabbit builds and uses well marked runways and tunnels in the long dense grass in which it lives. We hope that these volcanoes stay

quiescent or that the species spreads its range, for such a creature should not pass into oblivion until it is better known.

The pikas, which have many pseudonyms, including that of coney, rock-rabbit, and hay-maker, do not live near to man, but in this country spend their lives along the edges of the talus slopes, usually high up in the mountains. Some colonies live in broken lava fields not far above the level

of the sea, but these stranded explorers are far from their ancestral haunts. The only reason one can see for a pika living where he does is through a



preference for solitude. Occasionally he has a neighbor in a whistling marmot. Porcupines sometimes den near him. Hungry coyotes vainly stalk him, and hawks swoop close in search of an unwary individual. Once while I was seated patiently with gun on knee, trying to see some of the dozen pikas that were calling near me, a hush fell suddenly upon the rocks, and then I saw a long brown weasel hastily cross the length of the slide, himself intent on the same game as I. But neither he nor I succeeded there that day.

Do not search for these evasive creatures near the center of a large expanse of rock, for they must feed, and their food lies not



*Photograph by J. H. Batty*

#### BABIES OF MEXICO

Born as hairless and as helpless as a human baby, these rabbits in a week can hop about and play with evident enjoyment

#### SKY HIGH

The Jack rabbit sometimes takes great leaps for observation



within this great débris, but at its edges. No heap of rock is too small for them. In a forest I have heard a pika call from a pile that a driven prairie hare could cover in one leap. This pika gave himself to science.

In clear weather pikas busy themselves cutting hay and carrying this to a spot where the sun will reach it. Here the hay dries, and, when the snow comes, provides ample food for the pika in his vast playhouse underneath the snow, while above, the improvident rabbit often starves.

The rabbit kind were given no defense and little brain. Theirs is the rôle of changing grass to flesh for the delight of carnivores and man. Their only hope is in their fleetness and ability to hide, which, coupled with a fecundity notorious, has given them ascendancy. Foxes, wolves, dogs, and coyotes, cats of many kinds, relentless weasels and their kin, hawks

and owls, snakes and man, all pursue and kill, and yet the rabbits do increase until a plague sweeps through their ranks, or famine brings them back to their proportionate share of nature's bounty. Man sometimes grows impatient awaiting the inevitable, and, in a single day of beating a great rabbit country toward a corral, will take a toll of twenty thousand lives. Thus they do things in California. But the hares need little time to refill depleted ranks, and one soon hears again of a farmer's haystack being completely devoured by the hungry hordes.

The life span of a hare has been known to reach a dozen years, within the confines of a cage. In nature, five no doubt would be exceptional. Faltering faculties make a creature in the wild an easy prey to all the hunting world.

If silence is a virtue, the rabbit is a leader in morality. Though equipped with vocal chords, the rabbits more commonly communicate by rubbing whiskers or by

The Marsh Hare Hiding



stamping. As yet no one has learned their code, but there can be no doubt of their intentions. A tame rabbit on a tambourine may be taught to talk in this first sign language at request. In terror rabbits do forget their manners and shriek a loud and pitiful *quaa-a-a-a-a* but they rarely utter other sounds.

Bearing out the attestation of good character that his silence shows, we note the rabbit almost never winks. But watch his nose and lengthened whiskers tremble! Winking is but a safety valve for nervous energy that finds an outlet in such small movements as in rolling eyes, twitching nose, or chewing. The rabbit finds relief in his moustache.

The lagomorphs are known as rigid vegetarians, and for the better part this is true. Yet, with the placidity of a scorpion the buck will eat its new-born young, at least when he is in a cage. Northward, the hares sometimes gnaw the frozen carcasses of their own kind, or on occasion, other meat. Fresh blood, however, is known as a most successful repellent wash when used on fruit trees. A strange defence against a cannibal!

Why is it that the rabbit will not bite? In handling even the largest and most protesting bucks one only needs to guard against the sharp and ripping claws. No provocation induces



Photograph by G. H. Sherwood

#### CONFIDENCE

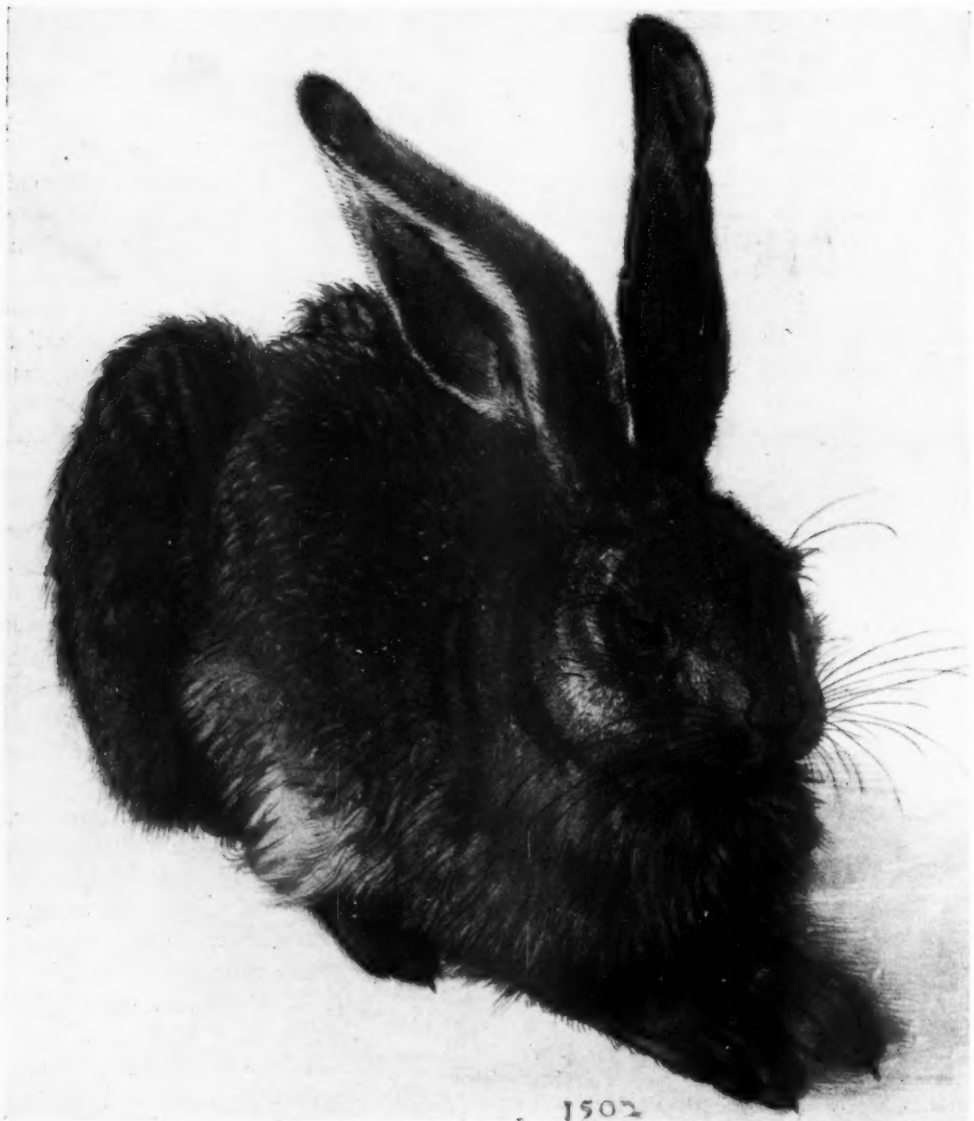
These youngsters, born within a shallow fur-lined cup on a New England lawn, show no fear of their gentle captor but only bury their noses in the shade to escape the brilliant sun

them to use their teeth that look so dangerous. In fighting among themselves they use their teeth as well as claws, but towards a stranger never take the thought.

Speed is an attribute of prairie and of desert living creatures. Of our mammals, the pronghorn is the swiftest, but now that the pronghorn is all but gone the prairie hare holds honors. There is a saying among the cowboys that one has a good horse if one can follow a jack rabbit so fast and

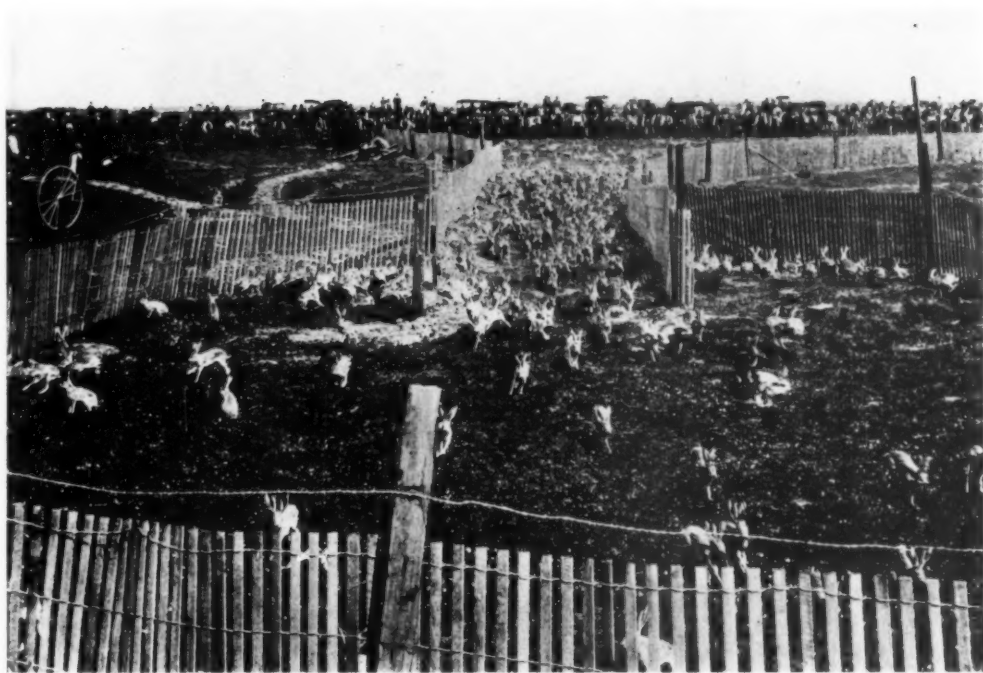
so far that it is forced to lay down its ears. Thirty miles an hour is perhaps the best the hare can really do. The polar hare hops along on his two hind feet as does a kangaroo, but gains no speed by it.

Man has long esteemed the flesh of rabbit. There are evidences that before historic times he took the timid hare with arrows, and by snaring. In Rome's ascendancy the Hippodrome was converted into a small forest and stocked



FELD HASE

*From the drawing by Albrecht Durer*



Courtesy U. S. Biological Survey

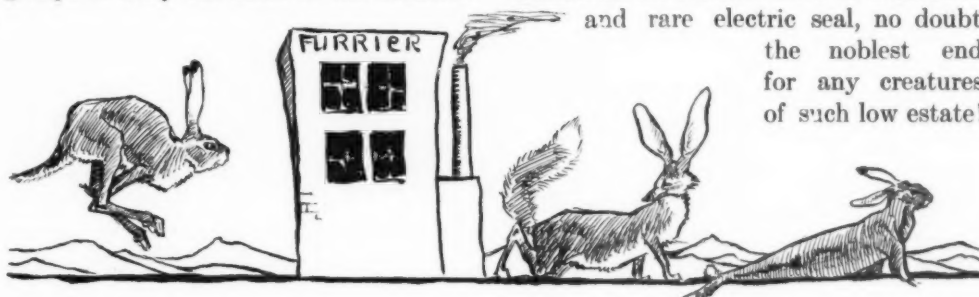
#### CATCHING RABBITS WHOLESALE

This old picture from California shows the end of a "rabbit drive." Because of the damage done to their crops, the farmers often organized these drives, thus corraling and killing thousands of the creatures

with rabbits, hares, and other game. The people then were given entrance and every person was allowed to retain the animal which he or she could seize and carry home. *Civet de lièvre* and hasenpfeffer may justly stimulate the palate of those that know them, and among some groups in Italy the meat of the domestic

hare is the only one that supplies the table in ordinary times. The rabbitries do less well here.

Felt, jujube, gelatin, and glue have long been made from rabbit hides, while now our clever furriers have found it feasible to do what nature couldn't, and transform the humble hare to Baltic fox and rare electric seal, no doubt the noblest end for any creatures of such low estate!







## MARCO POLO'S SHEEP

Collecting *Ovis Poli* in the High Pamirs. An Account of One Phase of the Morden-Clark Asiatic Expedition of The American Museum of Natural History

BY WILLIAM J. MORDEN

Field Associate in Mammology, American Museum

THE snow fell steadily, blotting out every feature of the Pamir landscape. The peaks that rose about us were lost behind the falling curtain of white, and the details of the landscape were completely obscured. Through the numerous openings in the roof of the native "yurt" that had been loaned to us, the snow fell to the floor, melting near the fire and accumulating in tiny pyramids near the felt-covered wall.

We had been on our way for thirty-five days, and now were actually within Russian territory, high in the valleys of the Pamirs—actually camping on "the roof of the world," in the region that is the natural home of *Ovis poli*, which we had come to find. We had struggled over the Burzil Pass from Kashmir, had crossed the Himalaya through Gilgit and Hunza with sixty coolies carrying our belongings, had crossed the snowy Karakoram into Chinese Turkestan, and there, close to the Russian border, below the notch of Peyik Pass, had camped and sent a messenger with our various papers over to the Russian army post of Kizil Rabat in order that we might be assured of a friendly welcome in that remote and jealously guarded military territory.

Nor had we been certain as to the kind of a reception that we might expect. Stories of the most discouraging kind had been told to us by our interpreter, and by the natives with whom we had come in contact. We had been assured that the best we might hope for was arrest and deportation, and that our belongings would most certainly be taken from us. But we had letters from various officials—Russian and others—and even had a special permit from Moscow, so we persisted. But we were not certain, despite our Moscow permit, that the guardians of this distant Central Asian outpost had been notified of our coming, and consequently could not tell just how they might decide to welcome us.

But now, as we sat about the smoky fire of yak dung, and tried laboriously to converse with the Russian captain who had been assigned to us as a sort of companion, we were very much at peace with the world. The Russians at the army post had received us in the most friendly manner possible. We had actually seen a herd of thirteen *Ovis poli* rams within an hour after we had crossed the Russian border, and now, save for the snow-storm, we were ready to begin the work that had led

us to that distant and rarely visited portion of Central Asia—we were ready to begin the collection of a series of *Ovis poli* for The American Museum of Natural History, before marching to the east and north to carry out our other plans in Chinese Turkestan and in Mongolia.

Thus it was that we sat about the fire and conversed, through a series of three interpreters, with the youthful captain who had come with us to our camp where it was located ten or twelve miles inside the Russian border, and fifteen miles or so from the Russian army post at which our official reception had taken place.

We were anxious, of course, to be out along the ridges in our search for the poli, and we peered forth periodically at the clouds, hoping to see them clear away. For three long years I had been planning for this very time, and I was impatient at being held up by a snow storm now.

I had fortunately been able to interest Dr. Roy Chapman Andrews in my plans, and through him President Henry Fairfield Osborn of The American Museum of Natural History had become acquainted with them and had been good enough to detail Mr. James L. Clark, of the Museum staff, to accompany me. And now that Clark and I were actually on the ground—now that we had seen, on the distant slopes, a beautiful band of the supposedly rare animals that we had come to find, we found the little delay caused by the snow storm unduly trying and prolonged.

The smoke of the fire half filled the *yurt* that had been set up for our benefit, and the much translated conversation with the Russian captain grew less and less interesting. We smoked and stirred the fire. We rolled up in our blankets as night fell and awoke to find the snow still falling. But finally, about noon, the



BURDEN BEARERS OF THE PAMIRS

Porters and yaks of the Morden-Clark Asiatic Expedition among the snows of Central Asia. In order to hunt among the Pamirs the yaks were almost essential

storm began to clear away. The late afternoon was perfect, and the atmospheric clearness, when the sun shone, was amazing. Hills near camp, probably five hundred yards away, looked as though one could throw a stone to them, while distant mountains stood sharply cut against the sky. Fresh snow lay everywhere, whitely softening the sharp contours of rocks and hills.

The ending of the storm gave us our first opportunity to hunt, so we arose at three-thirty next morning, by the light of a pale last-quarter moon. It was bitterly cold, for we were camped at an altitude of fourteen thousand feet. All our fuel, too, was wet, and the little fire that tried to blaze in the middle of the yurt was mostly smoke. We hurried into frozen clothes and ate a hasty breakfast which cooled as rapidly as it was brought from the cook

yurt. Before daybreak we were on our yaks, ploughing through deep snow up the valley. There was no wind at first, but the still air was icy and the temperature was well below zero. The sun, which reached us about six-thirty, did not moderate the cold for at least an hour.

Shortly after sunrise, a band of thirty *poli* ewes on a hillside ahead caused a halt, and the Eyemo camera was set up and some motion pictures made with a telephoto lens. Several ewes came to within about two hundred yards of our position, stopping now and then to stare at the dark objects below them. We were able to get some excellent motion pictures, the first ever made of live *Ovis poli* in their native range. These, with other motion and still pictures obtained later, made a series which supplemented the specimens and added to their scientific value.



RUSSIAN SOLDIERS STATIONED IN THE PAMIRS

These men received Mr. Morden and his companion cordially, and made every effort to assist them in their arduous hunt for *Ovis poli*. Mr. Morden is on the right of the picture and Mr. Clark, the assistant director of the American Museum, is on the left

ON THE LOOKOUT FOR *OVIS POLI*

Telescopes were essential in hunting the wary animals. Only by locating them at great distances, and stalking them very carefully, could they be approached at all

Several rams were sighted on a ridge across the valley about a mile ahead and we at once stopped to examine them from the protection of some jutting rocks, though they were very far away for a detailed view. Soon, however, they came down hill in our direction and passed out of sight behind a ridge. Just as we started forward, they reappeared and moved leisurely upward again, while twelve more rams came down from our side, crossed the valley and joined them.

The whole band went about half way up the snow-covered slope, and began to paw through to the grass beneath. The snow was about two feet deep, but they seemed to have little difficulty in traveling or in reaching through it to the ground. They were a wonderful sight, those twenty big *Ovis poli* rams; I do not suppose there were horns in the lot which measured less than forty inches.

About noon the rams arose one by one, pawed about for a short time, and then casually followed a leader along the slope over a ridge. Immediately the last disappeared, we hurriedly collected our belongings and were off after them. It was a long breathless climb through deep snow but we finally reached the ridge over which they had crossed. While traversing a long slide of broken rock, I noticed a pair of horns outlined against the snow on a ridge some two hundred yards ahead. Glasses showed one of the rams lying among rocks, with another just above him. As we watched them, they suddenly saw us, probably alarmed by movements of the native camera-carrier, who tried to crawl upward. They arose at once, of course, looked for a moment, then dashed upward. When we arrived at the ridge, the whole herd, which had been lying among the rocks of a shallow depression, had dis-

appeared over the next ridge. There was nothing to do but return to the yaks and make for camp, as a snow-storm had started which promised to become thicker as darkness approached. So ended the first day's poli hunting, with some knowledge gained but no specimens collected.

Snow, which precluded any possibility of hunting, continued all night and much of the next day, which we spent in camp. One more day was spent hunting from that camp but the snow was so deep that we could accomplish little. Twenty-two rams were located and examined through telescopes; one, estimated as being fully fifty five inches, was shot at long range and found to measure but fifty two inches around the curl of the horns. Experience in judging sheep heads is of little use when hunting poli, we found. I had thought that I was a fairly competent judge of wild sheep horns, as I had previously shot seven

species in North America and Asia, but I discovered that the wide sweeping curl of the horns of Marco Polo's sheep is very deceptive. British sportsmen who have hunted in the Pamir region have met with the same difficulty.

Deep snow and daily storms made it advisable to move the scene of our hunting farther into the country where, according to reports, we would find poli more plentiful and would not be handicapped by such deep drifts. A two-day journey took our small caravan past the army post at Kizil Rabat to Ak-tsoi, a district of the "Little Pamir" near the Afghan border. On the way we stopped for a short visit with the Russian officers, who very thoughtfully sent messengers ahead to some native camps, so that *yurts* might be ready for our use. The commander asked how many poli we wished to shoot. Receiving our reply that ten would



MR. MORDEN ON HIS STEED IN THE PAMIRS

Yaks are surefooted, phlegmatic animals, that are given to stubborn spells that no amount of effort seems able to overcome. On one occasion a balking yak had to be left on the trail, where he remained without moving a dozen feet for three days, when one of the natives brought him into camp





#### OVIS POLI HORNS

Throughout the Pamirs the horns of dead poli are occasionally to be found scattered about. The natives kill large numbers of them, but, of course, have no use for the horns, and consequently throw them away. Sometimes, too, many of the animals die during unusually hard winters

probably be sufficient, he seemed surprised and suggested that we had come a long way, spent much money and endured great hardships for such a small number. His idea that a hundred *Ovis poli* would be about the proper number amused us, though it was cheering to learn that the animals were plentiful.

As we approached the site of our new camp at Ak-tsoi there appeared, high on the mountain just behind it, two bands of poli ewes and young. We counted eighty altogether as, stopping frequently to look at us, they went slowly upward.

Several days spent in combing the country around Ak-tsoi, showed us that, though poli were there in large numbers, it was a most difficult district to work. Valleys were open and almost without cover, making long waits necessary to approach herds closely enough even to judge the sheep. Furthermore, we saw no

large heads, though some two hundred rams came at various times under our observation. Nor was our campsite ideal, for melted snow was the only water supply and yak dung for fuel had to be brought several miles. So, when the Kirghiz told us of another district, called by them Dung-gelduk, two marches away, we decided to move again.

The first three or four miles of the trail from Ak-tsoi was up a wide valley in the midst of a white world where snow covered everything to a depth of fully two feet. Just before leaving the snowy valley for a smaller and more rocky, but less white one, eight poli were sighted. One of them proved to be interesting, and a sharp dash across the valley brought us behind a steep little ridge, up which we trudged on foot. But we made the mistake of not following the sheep-hunter's maxim, "when in doubt go to the top,"



#### SEARCHING A VALLEY FOR *OVIS POLI*

As with other mountain animals, *Ovis poli* tend to escape from their enemies by leaving the valleys for the crests of the mountains. Thus the hunters made it a point to scale the mountains very early in the mornings, in order to lie in wait for them there

and found ourselves suddenly looking eye-to-eye into the face of a small ram. He wasted no time trying to stare us out of countenance but joined his friends, and the eight began to make sheep-tracks. I was able to stop the last one, which, while carrying horns of but fifty inches in curl, gave us an almost undamaged complete skeleton, a necessary and welcome addition to the collection.

Our Kashmiri staff and the pony-men, being Mohamedans, were constantly asking us to shoot many *poli* and to allow them to cut the throats and so make *hallal*, without which no true believer may eat the meat. But as I had previously had experience with *hallal* in Kashmir, when some specimens were ruined by having the necks badly slashed, I refused permission for any of our men, except the head *shikari*, to touch the animals, and promised to buy the staff some domestic

sheep at the next Kirghiz camp.

Following our packtrain, we reached a wide valley where we found a *yurt* ready for us in a large Kirghiz camp of five families, surrounded by herds of sheep, yaks, and camels, and as usual, many snarling dogs.

When we wished to buy two sheep, we were asked twenty-five rupees each and were told that in the city of Andikan sheep cost from fifty to sixty rupees each. Yaks were said to be worth about a hundred and sixty five rupees each. At that rate, all the people around there were rich. We heard a tale of five men who got together ten *lakhs* of rupees (one million rupees) and bought sheep and yaks on speculation. They drove the animals to Andijan and sold them at a comfortable profit. And those were the people to whom one was supposed to give *bakshish*!

Next day, two *yurts* for our use were

dismantled and loaded on four protesting camels, which were added to our caravan of twenty ponies and six yaks. A march of about ten miles brought us into the long narrow valley locally know as Dung-gelduk *Jilga*. Just after entering the valley we saw fifteen poli on the hills and while we were looking for a campsite, a band of thirty ewes and young appeared about a mile beyond.

The day after our arrival at Dung-gelduk, Clark and I went with three natives to look over the nearby country. About a mile up the valley, one of the natives spied something far ahead. Through glasses, we made out a large bunch of sheep, so we left the yaks and crawled to a little rise. There were thirty-eight rams, of various ages and sizes, in the first lot, with several herds in the further distance, totaling, altogether, fully one

hundred *Ovis poli* within our view. We decided that we should back trail and cross a deeply snow covered summit behind the sheep, in the hope of getting above them.

We walked up a sloping fan, and stopped among some large boulders to have another look at the rams. At first they could not be located. Then we discovered that the herd of thirty-eight had split: eight had descended to the frozen stream bed while the remainder had climbed higher up the slope. We cached ourselves among the rocks, while the eight rams ascended the opposite side of the valley, fed a bit, lay down, got up and slowly worked upward but slightly towards us. They finally lay down in an exposed position and we began a vigil that lasted from just after daylight till midday. One person was always on the



A FINE MALE POLI HEAD

The largest head collected by Mr. Morden carried horns that measured  $57\frac{1}{2}$  inches around the spiral, and very few were seen with horns so massive



IN A HIGH PAMIR VALLEY

The whole district of the Pamirs is above the tree line, with the result that the region seems singularly bare and forbidding

lookout at the fifty power telescope. The rams lay among rocks and snow, and one showed a head which seemed to have a remarkable curl, even though we had long since become skeptical regarding first impressions of poli horns. "Colonnas," the Turki word for big, seemed to be frequently used in conversation between the natives, so we had hopes, though disappointments had made us want to read the tape before passing judgment on a head of Marco Polo's wild sheep.

The usual daily storm came up the valley and when the snow squall grew more dense, we chanced a move. At the bottom a projecting spur hid us, so we mounted our yaks and hurried across to the further protection of other ridges. We continued about half a mile, at last leaving the yaks tied, or rather anchored, to boulders, and crept forward and upward over broken rocks and snow. Dur-

ing a short halt for breath, we discovered that the rams had arisen and were coming across the slopes in our direction. We hurried onward to some large boulders near the edge of a dry wash which gave an opportunity for concealment. While one of the men was carefully scanning the upper slopes I happened to look past his shoulder and was startled to see three white rumps not over forty yards away. I nudged one man, "shushed" the others who were just behind, and we watched the three rams. Unfortunately I had "frozen" in a most uncomfortable position, but there was no chance to shift as they leisurely fed down toward us. One passed out of sight not over fifteen yards away. Marmots were whistling in the valley and this danger signal frequently caused the rams to jerk their heads erect. None of the three had big horns, though one of the natives tapped my foot and

made motions that the lower one was very large. That is one trouble with local *shikaris*; be they ever so good hunters and stalkers, when they get close to game, every head is a big one.

How long we lay within thirty yards of the three rams, would be hard to say. It seemed a long time to me, for though intensely interested, my cramped position took much of the joy from the situation. At last I thought there was a chance to shift slowly, while all three had their heads down feeding. I eased over, moving my rifle as I did so. This brought me facing uphill, a direction in which none of us had been looking. Not over twenty-five yards away stood a big ram, which none of us had seen, staring fixedly at the strange objects below him. I was quite as startled as he, but managed

to keep some of my wits about me. His horns at that short distance looked huge. As I gradually swung around facing the big fellow, he jumped and dashed up the hill. There was a momentary glimpse of several other great heads and then all disappeared. Luck was with us, however, for the rams, true to their instinct, ran directly uphill away from the source of danger. They made a glorious picture as they bounded over the snow, but we had little time at the moment to admire them.

We followed breathlessly, and at the crest we saw them again. One of the natives, excitedly using the glasses, indicated that the leader was the largest. It was a very simple shot, not over fifty yards. Another was easily accounted for; two hurried shots were misses but the fifth brought down the third ram. We



JAMES L. CLARK, WITH A FINE HEAD

Of the two finest heads obtained by the Morden-Clark Expedition, Mr. Morden secured one and Mr. Clark the other. The difference in size between them was very slight. When the Russian soldiers were told that the object of the expedition was to collect *Ovis poli*, they expressed surprise when they were told that about ten specimens would be enough. They felt that having come so far, the expedition could hardly be satisfied unless they obtained a hundred



watched the last, which was thought to be smaller than the others, until he neared the top. Suddenly the man with the glasses whispered that this one had a head fully as large as the first and we were fortunately able to stop him just as he was disappearing behind a ridge. All were within a hundred and fifty yards—a rare bit of luck which gave us four excellent specimens, the finest we had seen.

The first ram proved to have the longest curl— $57\frac{1}{2}$  inches, with a spread of 41 inches and a base of  $14\frac{1}{2}$  inches. He was ten years old, according to the record of the annular rings of his horns. Though his horns were slightly longer than those of the other rams, which were  $56\frac{1}{2}$ , 55, and 56 inches, respectively, they measured less around the base. The others were noticeably heavier, the largest being  $16\frac{1}{2}$  inches.

From experience gained in measuring many old heads, from study and observa-

tion of fully a thousand living animals, and from the specimens collected by us, we came to the conclusion that the present average length of adult *Ovis poli* horns is about fifty-two inches. Doubtless there are many living poli with horns of much greater length; very possibly a world's record now ranges somewhere among the secluded valleys of the Pamirs, but both Clark and I are thoroughly convinced that during our month we saw none larger than the  $57\frac{1}{2}$  inch heads we obtained. From examination of old heads and of those collected, our judgment is that sixteen inches is nearly a maximum base measurement; probably an average circumference would be about fifteen inches for fully grown rams.

In general, the horns of *Ovis poli* form an open spiral, extending widely from the face and making more than a complete circle. Usually they are not "nipped in"



LOADING UP FOR A POLI HUNT

The patient yak in the foreground is anchored by his nose rope to a boulder, and normally is perfectly willing to remain thus tied for hours at a time, even through a snow storm, against which he is amply insulated



## A PERFECT PAIR OF HORNS

Despite the great size of the horns, the poli is not a particularly muscular beast, and although it lives among rocks and dangerous ridges, its bones are light and comparatively brittle

at the bottom of the first curl, as are those of *Ovis ammon ammon*, their cousins of the Altai mountains. There were exceptions to this rule, however. Several specimens were observed to carry horns of the same type as those of *Ovis canadensis* of North America. One old fellow, whose right horn was broken about level with his face, had the left curving close to his cheek and up past his eye, with a curl much like that of a big Alberta ram. Others had the horns nipped-in close to the face with the wide flares typical of the Altai sheep.

All the sheep collected were in excellent winter pelage, their heavy coats making them appear larger than they really were. In early morning light and at a distance, poli appear creamy white with brownish saddles. Closer examination confirms the first impression except that between the white and brown there is an intermediate

grayish tinge which blend the two and runs up the back of the neck. The gray fades out just back of the horns, where the hair is almost white. The horns are yellow-white, much the shade of old ivory. In bright noon-day light, when the mirage makes all objects at a distance indistinct, counter shading will sometime cause a band of *Ovis poli* to become almost invisible against slides of broken rock not over two hundred yards away.

Summer coats, which are those most often seen on the specimens obtained by hunters, are short and differ somewhat from the winter pelage. The real winter coat can be seen only on specimens collected in the winter or early spring. We were most fortunate to be able to complete our work before the summer shedding began; it was just starting when we left the Pamirs.

The Pamir sheep are surprisingly

lightly built and their bones are very delicate for animals living in rugged country where travelling through deep snow is necessary during much of the year. Clark said that poli bones were more brittle than those of any other wild animal he had handled. Neither are these sheep exceptionally muscular, no more so, in fact, than the Virginia deer of North America. The necks of the rams seem lightly built for the carrying of such heavy heads. A carefully weighed ram totalled two hundred and thirty nine pounds, though in the fall he would probably have weighed from twenty five to fifty pounds more. There was practically no fat on any of the specimens we collected in the Pamirs; all were very thin, with ribs showing noticeably.

The lives of the poli must be made miserable by the great number of parasites infesting them. All adults collected by us

had quantities of grubs under the skins; sometimes large areas, especially along the back, would be found perforated by the repulsive looking insects, and the hair would be quite loose at those points. Grubs were found in the noses of many specimens and all were infested with ticks. The ticks probably caused the frequent rubbing against rocks which we noticed.

In the springtime the rams herd strictly by themselves and large males usually keep together, with sometimes a few youngsters of two or three years tagging along. We only once saw a band of rams with a yearling in it; the little fellow was so small he looked like a ewe, but he bore himself with all the masculine assurance of a youth out with his elders. Large herds of ewes and yearlings were common during early May, but about the twentieth the ewes became scarce and the yearlings were seen in groups by them-



A FEMALE POLI HEAD

It was difficult for the hunters to tell the difference, at great distances, between the females and the younger males. Closer inspection of the two shows that the horns of the young males tend to be slightly heavier than those of the females, but the differences are not obvious at several hundred yards



THE DESOLATE "ROOF OF THE WORLD"

Although the peaks of the Pamirs sometimes reach as high as eighteen or nineteen thousand feet, they do not give the idea of great size, because the altitude of the valleys is so great. Whole sections never drop below fourteen thousand feet, and most of the valleys appear more or less desert-like, as this picture shows

selves or with one or two immature rams. We first saw new-born lambs on May twenty-fourth, then in increasing numbers. The ewes probably seek secluded places among the peaks at lambing time, which would account for their scarcity at that season.

The first young lamb was pretty wobbly on its tiny legs and the solicitude shown by the mother was very touching. We first sighted the ewe from a distance and were attracted by her strange actions. She appeared lost, for she walked uncertainly forward, stood to gaze back, and then returned a little way, apparently to feed. It was only when we looked carefully with the telescopes that we could distinguish the tiny dark gray form of the lamb stumbling along after its mother. Later, when we tried to capture one of the youngsters, we

found that they attained surprising agility in a few days.

The spring diet of the *poli* is apparently limited. Here and there among the rocks grow tiny bunches of grass with wire-like leaves, and about the middle of May a variety of wild onion appeared in sandy areas. We saw the sheep pawing through the sand to obtain the first shoots of the onion which had not yet reached the surface. That these form a considerable portion of their spring forage was attested by the odor of the animals and the strong flavor of their meat. Later in the season there is probably more grass among the hills; when we left the Pamirs in early June a greenish tinge was becoming noticeable, particularly on the more sandy slopes.

Roughly, the range of *Ovis poli* may be said to extend from the Thian Shan Mountains on the north, south through



the Pamirs to the Valley of the Oxus, usually at an altitude of from twelve to eighteen thousand feet. In Chinese territory a few poli are still seen in parts of the Tagdumbash Pamir, but whether through years of hunting or other causes, this section is now almost devoid of them. On the west they are said to extend to the limits of the Pamir region; in other words, they are found practically everywhere in the Russian Pamirs. Though we hunted and traveled through a considerable territory in actual area, we saw but a small portion of their range.

Some zoologists consider *Ovis poli* as a race of *Ovis ammon*; other authorities place *Ovis poli* as a separate species of the genus *Ovis*. But such problems must be decided elsewhere, for it is not the province of this article to enter the field of technical discussion.

Back and forth across the ridges and through the high valleys of the Pamirs we hunted for a month. We studied poli through our telescopes. We stalked them along the rocky slopes. We photographed them, and now and then collected some

specimen that seemed to be what we wanted for the Museum collection. We were fortunate in finding another fine ram with heavy horns which measured 56½ inches; we added a two-year-old ram, a ewe, and two yearlings to the collection. And then Clark brought in a magnificent ram, whose splendid horns measured 57½ inches around their graceful curl. It made a fitting climax to our work in the Pamirs.

During our hunting we definitely found that these beautiful, spiral-horned sheep are not the rare and almost extinct animals that they had been thought to be. We actually counted a thousand and fifty two rams and more than six hundred ewes, and in these figures a generous allowance was made for possible duplication. Furthermore, we included none that were not counted either by Clark or myself. Many bands were reported by our native hunters, but these we did not count.

It is next to impossible to make any accurate estimate of the number of *Ovis poli* that remain in the Russian Pamirs, but certain it is that they are very far from extinct.



CAMP IN THE PAMIRS

The hut in the foreground is a *yurt*, which is a collapsible affair used widely through Central Asia. The sides are built of folding rods, covered with felt mats, and the top is supported by poles resting on the sides and about a ring in the center, where an opening is left in order to rid the hut of the smoke of the fire that is built on the floor





## A DRAMA OF THE MICROSCOPE

The Microscopic Life Found in One-half Inch of Pond-bottom Magnified  
One Hundred Diameters or, Cubically, One Million Times.

By ROY WALDO MINER

Curator of Lower Invertebrates, American Museum

*The new Rotifer Group in the Darwin Hall of the American Museum was designed and directed by Doctor Miner. The field work on which it is based was largely carried on at Mt. Desert Island, Maine, by Doctor Miner in collaboration with Mr. Frank J. Myers, whose intimate knowledge of rotifer anatomy, natural history, collecting methods, and microscopic technique were of inestimable value during the preparation of the group. The field color sketches were prepared by Dr. George H. Childs, under Doctor Miner's direction. The remarkable glass modeling which is the outstanding feature of the exhibit is the work of Herman O. Mueller, of Doctor Miner's staff of artists, and sets a new mark in work of this kind, both as an achievement in skillful preparation of the hundreds of component models, and in the successful assembling into one complex whole of a multitude of fragile parts. The delicate coloring of the models and background is the work of Mr. W. H. Southwick, while those features of the pond bottom constructed in wax were modeled by Mr. Chris E. Olsen.—THE EDITORS.*

**M**ORE than three centuries have passed since Zacharias Jansen of Middelburg, in the Netherlands, and his fellow townsman, Johannes Lippershey, produced two little instruments destined to have most far-reaching effects upon human knowledge. Both were contrivances in which crude glass lenses played a most important part. Jansen's invention was the first microscope, and was in use by 1590. Lippershey's was the telescope, which was sold by him in 1609. The following year, Galileo, in Italy, had heard of Lippershey's invention and spent a night considering the optical principles involved. By the next morning, he had reinvented the instrument for himself, and, a little later, adapted it for examining minute objects. Jansen and Lippershey were merely ingenious opticians. Galileo's adaptation of the telescope to astronomical purposes and the remarkable dis-

coveries he made with it have coupled the instrument inseparably with his name, so that he is commonly credited with its invention, and, according to an enthusiastic biographer, with that of the microscope, as well. While all credit is due, therefore, to the two Dutch opticians for originating the telescope and the microscope, it was the genius of Galileo that perceived the significance of the former instrument and by its aid he overthrew for all time the ancient Ptolemaic cosmogony, assiduously fostered by the ecclesiastics of the day, and demonstrated the truth of the essentials of the Copernican theory. From that time on, to all intelligent men, the earth moved around the sun. The world now knew that Jupiter had satellites, that the strange planet, Saturn, existed, and that there were spots upon the face of the sun, the observation of which proved its rotation.

While the microscope was not at first used for the study of natural history, by the middle of the Seventeenth Century, a group of keen observers, including Hooke and Grew in England, Malpighi in Italy, and Swammerdam and Leeuwenhoek in Holland, turned its magnifying power upon hitherto invisible details of animal and plant structure, and the last-named discovered the microscopic world of life.

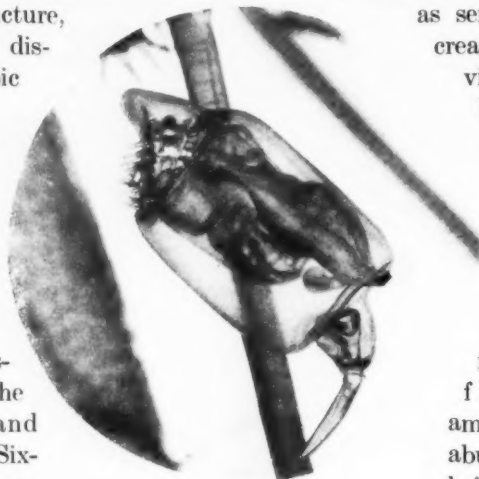
Men had formerly lived in a world bounded by the limits of their unaided eyesight. That which existed beyond was the subject of more or less fantastic surmise. While the mathematicians and astronomers of the Sixteenth Century dimly anticipated something of the truths of the universe outside the range of their visual apparatus, the invention of the telescope and the microscope suddenly furnished glass windows to the practically flat and two-dimensional room in which mankind had hitherto dwelt. Through the one they now gaze up into the starry heavens to see the planets swinging on their appointed courses around the sun. They penetrate interstellar space and comprehend that the twinkling stars are immense suns of other systems, that outside our universe are other unbelievably distant universes dimly shadowed like luminous cloud patches. Through the other window, the microscope, they gaze down into their own world of life, so enlarged by the magic of refracted light rays, that even the minute cells of animal and plant tissues are disclosed to view, as the fundamental units of

living structure. In a drop of pond water, Leeuwenhoek saw myriads of minute living creatures, the existence of which was hitherto unsuspected, because invisible to man's naturally coarse vision. These living beings crowd their watery habitat, hurrying hither and thither on the business of life,

as seriously intent as the creatures of our larger environment. Leeuwenhoek thus became the pioneer adventurer in this new world, which interpenetrates our own so intimately, and yet, through the accident of size, is so immeasurably separated from us. He was amazed at the variety and abundance of these tiny beings and his writings betray his confusion of mind. His letters, published from 1673 to his death in 1723, largely written to the Royal

Society of London, were filled with accurate but yet miscellaneous descriptions of his observations. They were accompanied by a wealth of drawings, remarkably faithful, considering the time in which he lived and the crudity of his instruments. For his microscopes were mostly simple magnifiers, which he ground and mounted himself. He possessed 247 of these, containing 419 lenses, which apparently gave him magnifications of from 40 to more than 270 diameters. They must have been of fine quality, for the most part, judging from his results.

Among the most conspicuous of the microscopic creatures that attracted Leeuwenhoek's attention were the animals since known as rotifers, of which he pub-



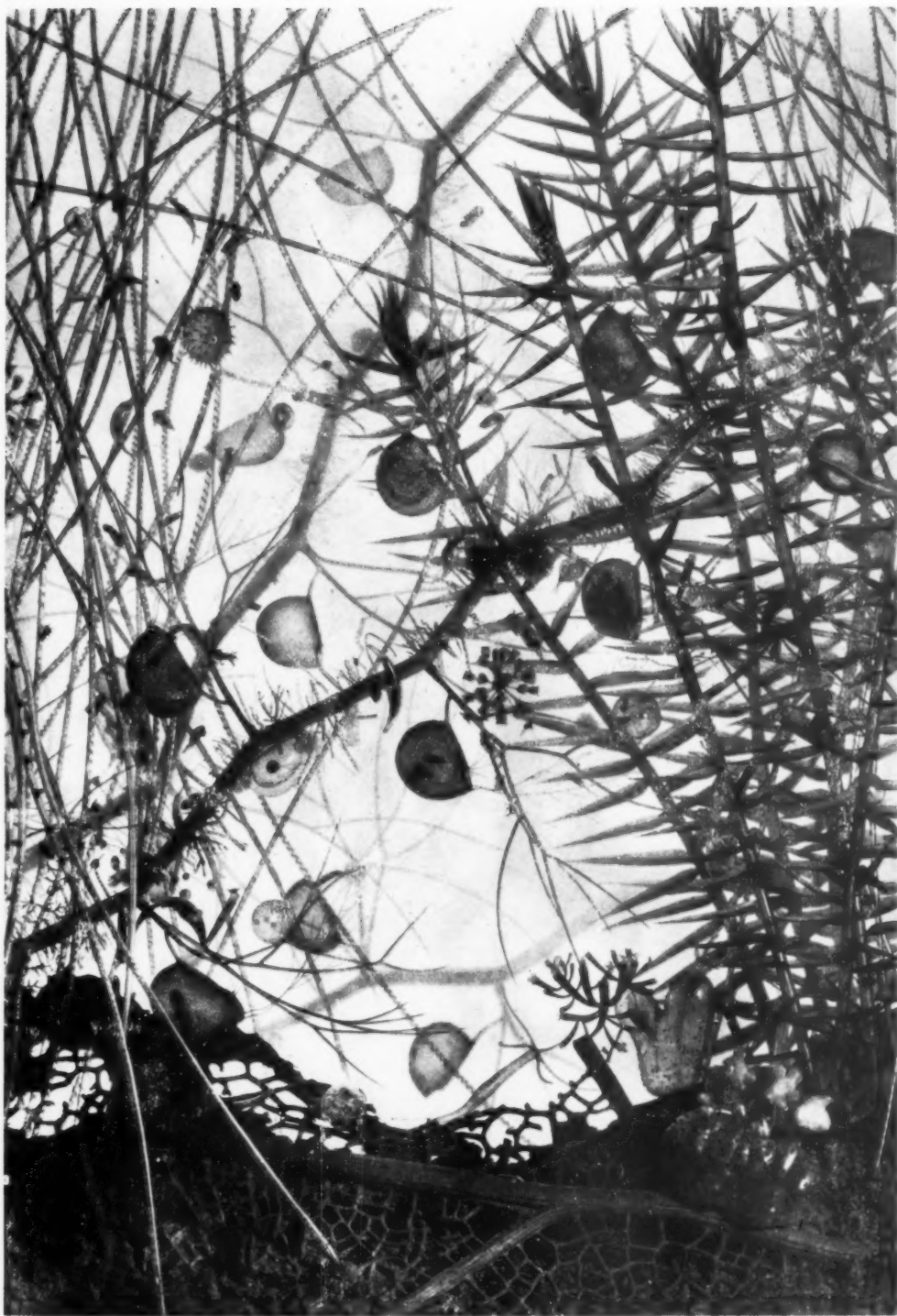
A SAVAGE ROTIFER

*Dicranophorus* crouching to spring upon its prey. Lightly balanced on its pointed toes, with body contracted, it awaits an unwary victim

### *Errata*

Through an error in correcting proof, the scientific name of the water thyme, *Philotria canadensis*, is wrongly applied in this article to the bladderwort, instead of the correct name, *Utricularia vulgaris*, in the captions on pages 503 and 507, and in the text on page 506, line 26.





A ROTIFER JUNGLE SEEN THROUGH A MICROSCOPE

The new Rotifer Group in Darwin Hall of the American Museum, exquisitely modelled in glass, represents a cubic half inch of pond bottom magnified one hundred diameters, or, cubically, one million times. A spray of the carnivorous water plant *Philotria* spreads its bladder-shaped animal traps diagonally across the field of view, to snare the microscopic rotifers and other tiny creatures which make up its food

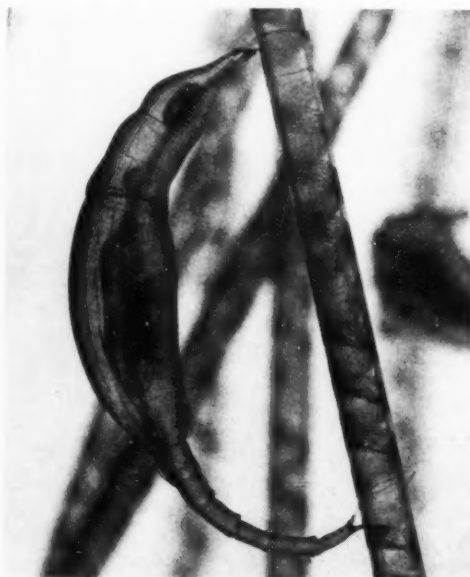


lished descriptions in 1703. A contemporary investigator, the Rev. John Harris, antedated him by seven years in making the first published, but rather vague, description of an undoubted rotifer. Thus, these remarkable inhabitants of the minute world, first recorded in 1696, have been known to microscopists for 230 years. Yet it is quite likely that by far the greater majority of educated persons today have never heard of them, and at the first mention of their name, would immediately ask "What is a rotifer anyhow?"

The new exhibit in the Darwin Hall of the American Museum is intended to answer this question. Rotifers are unknown, simply because of their small size. The new Rotifer Group enlarges a cubic half-inch of their watery habitat, to one hundred diameters, or, cubically, one million times, so that it occupies a space measuring fifty inches, or more than four feet across. The front of the exhibit is constructed to represent a huge magnifying glass, through which the visitor peers into a jungle of water plants peopled by hundreds of tiny animal forms. In their natural size, these plants would cross and recross an area about the size of one's thumb-nail. Here, they are so greatly enlarged that they appear to tower above the observer's head, and their great size gives them a strange and unfamiliar appearance. These and all the other re-

markable and complex features of this group have been skillfully modeled in glass to represent the life of a minute area exactly as it appears through a microscope. To the right, a cluster of water thyme (*Philotria canadensis*) rises with slender, pointed leaves and graceful translucent green stems. To the left,

and arching also over from the right, criss-cross tangles of *Spirogyra* interweave their slender, tubular strands. When seen in natural size, this plant appears to consist of close tangles of slender silken threads of green, which gather in great masses in still water, and is familiar to us all under the name of "pond scum." It is supposed by many people to render the water noxious. The opposite, however, is true, as the green



A ROTIFER CLIMBING UP A PLANT STEM  
With swimming discs folded in and concealed, *Rotaria macrura* hunts for small organisms along a *Spirogyra* stem, advancing like an "inch worm" by alternately arching and extending its body

color of the scum is due to the abundant chlorophyll, which, under the action of sunlight, breaks up the harmful carbon dioxide gas of stagnant waters, utilizing the carbon for food, and releases free oxygen, thus rendering the water purer. In the magnified representation of *Spirogyra*, shown in the group, the strands are seen to be formed of cylindrical cells set end to end, and the green chlorophyll is gathered into spiral bundles (chromatophores), giving the strands of the plant a spirally striped appearance. Hence, the name, *Spirogyra*, is quite appropriate. When two strands of *Spiro-*



FLOWER-LIKE ROTIFERS SETTLED IN A NOOK AMONG THE WATER PLANTS

A colony of tube-building rotifers (*Flascularia ringens*) has built a branching cluster of trumpet-shaped "houses" on the edge of a dead, skeletonized leaf. In the center is the transparent, double dwelling of a pair of graceful, comb-armed rotifers (*Stephanoceros fimbriatus*), which are really ingeniously contrived animal traps of voracious habit. In the foreground, the large and unusually beautiful *Octotrocha speciosa* peer out of their jelly-like habitation

*gyra* come in contact, the cells which chance to be closest send out hollow projections to fuse with those of the opposite strand and connect the cells in pairs. The chromatophore of one cell of a pair thus united, then passes out of it through the connecting canal into the other cell and unites with the substance of its chromatophore, forming an oval body, which, after union of the cell nuclei, becomes a spore. This is released into the water and eventually starts the growth of a new plant.

Diagonally across the center of the group is seen the most remarkable plant of all. This is the bladderwort, *Philotria*. Its stem is slightly zigzag, and, through its translucent walls may

be seen the green vascular bundles of the internal structure. Along the stem, at intervals, are slender, branching, spine-like leaves, which, in real life, are very delicate and flexible. From the stem of each of these grows a curious bladder, also called a utricle. These bladders give the name, bladderwort, to the species. From the word, utricle, is derived the former scientific name, *Utricularia*. These utricles are actually animal traps. They are about the size of a pin-head, but are shown here, modelled in glass, about three or four inches in diameter. The tiny animals, with which our microscopic world is swarming, are captured by these traps and, as they die and decay, are absorbed by the plant cells for food.

This reminds us of the terrestrial pitcher plants, which capture and digest insects on land. Growing upon the main stem of the bladderwort, we see hosts of minute plants, the unicellular algæ. These are of many varied species, and are so crowded together that they appear like a fine green or brown fluff when seen by the naked eye.

We have examined the vegetation of our microscopic jungle. Let us now become acquainted with its inhabitants, the minute creatures that swim or prowl through its tangled growths or build crystal palaces, in which they dwell upon its branches.

As above mentioned, the most conspicuous of these are the rotifers. The typical rotifer is



THE TIGER SPRINGS

The *Dicranophorus* darts upon its victim with open, pincer-like jaws (seen at the right), and relaxed and now slender body. This is the same species of rotifer as the one shown on page 502

a somewhat top-shaped animal, that is to say, its body tapers from a relatively large, often flattened head, to a more or less pointed foot, usually furnished with two, likewise pointed, "toes." An excellent description with illustrations was given in a recent number of *NATURAL HISTORY* by Frank J. Myers, in an article entitled "What is a Rotifer?" (May-June, 1925, page 211.) The head has a crown of cilia, i.e., minute moving hair-like structures. The arrangement of this "corona" varies in different species. In some cases, as in the common rotifer (*Rotaria macrura*), these cilia are arranged in a double row around two circular discs, which are literally borne on the shoulders of the animal, just back of the



#### A WATER PLANT THAT TRAPS AND DEVOURS MICROSCOPIC ANIMALS

A detail of the Rotifer Group showing a single "utricle" of the bladderwort (*Philotria canadensis*). This, in the living plant, is about the size of the head of a pin. The trap-door is seen at its lower right margin and a captured rotifer is visible within. A spherical, floating colony of rotifers which cling together by their toes (*Conochilus hippocrepis*) is seen at the right. The stem of the bladderwort is covered with tiny, fresh-water algae, and a crescent-shaped desmid (*Closterium*) shows at the left

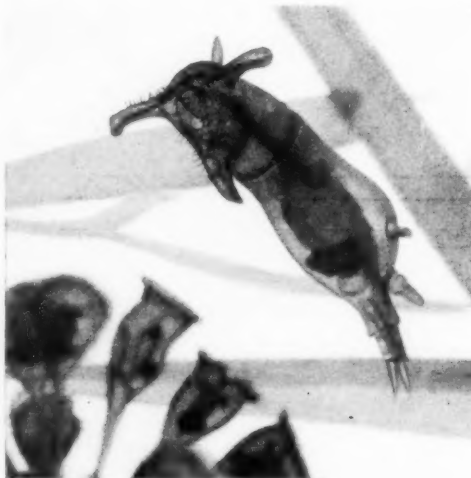


A ROTIFER WHICH LIVES INSIDE A  
COLONY OF PROTOZOA

The spherical colony of the protozoan, *Volvox*, is penetrated by the rotifer *Ascomorpha*, which thereafter lives and feeds inside

mouth-opening and on either side. The cilia lash the water, not indiscriminately, but one after the other in ordered succession. This vibrating movement is so rapid that a wave of motion passes around the discs, giving the appearance of a rotating wheel. Some of the early observers supposed that this was actually the case, and so gave the name rotifers or "wheel bearers" to the animals. They thought that, at last, the principle of the wheel had been discovered in nature, but, with closer observation, it was soon found that this was an optical illusion, and that man still preserves intact as his own invention one of the few mechanical principles not anticipated by nature, namely, that of the wheel rotating upon an independent axis. The rotifer's vibrating coronal circlet of cilia creates a whirlpool in the water, which gathers in still more minute animals, diatoms, and other microscopic particles to be swept down into the vortex where the wide-open mouth is situated. The food stream then passes into a capacious pharynx, to be seized upon by a curious apparatus, peculiar to rotifers, known as

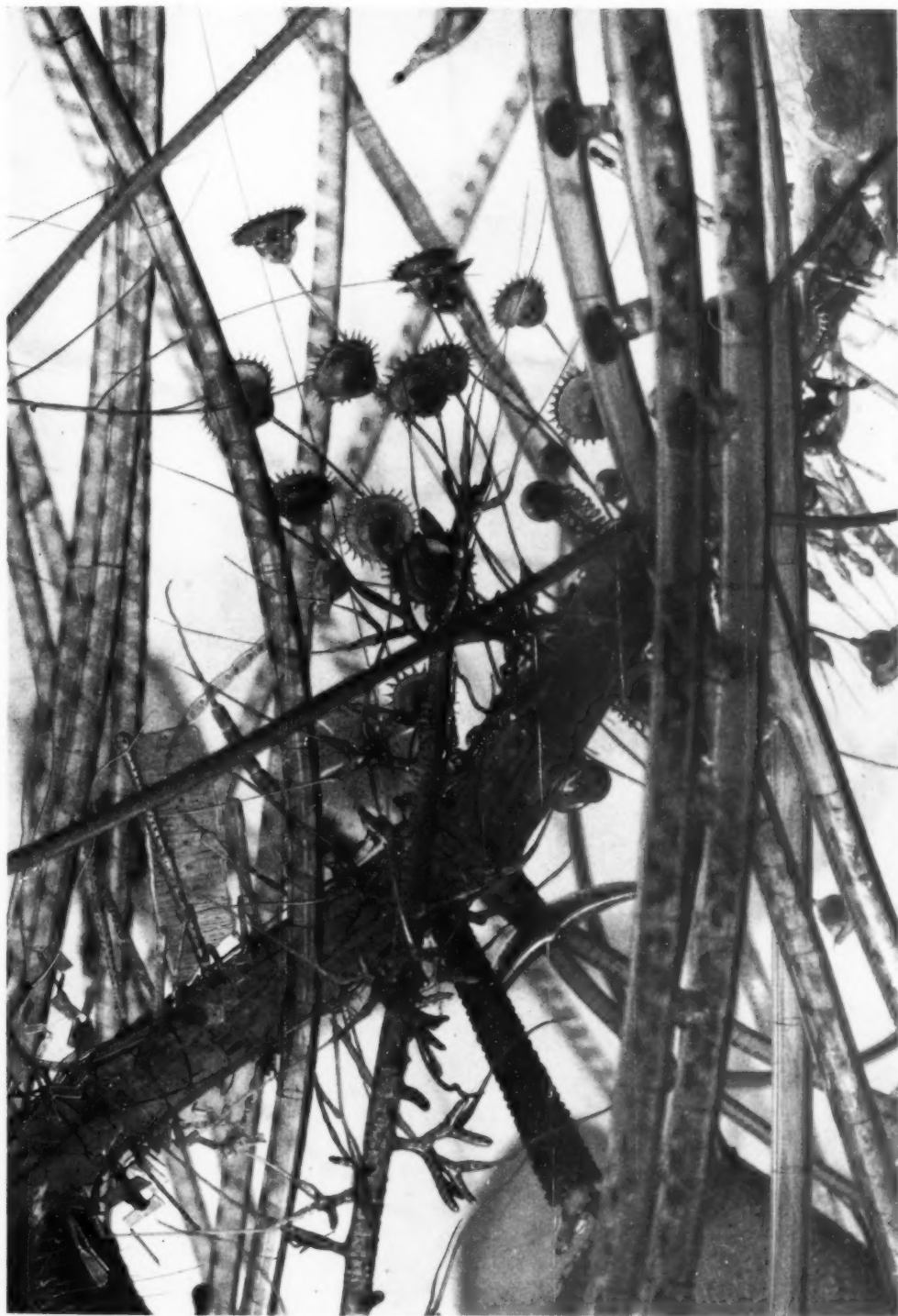
the mastax. This is really a set of jaws located in the throat, which differ characteristically in the various species, so that they are used by students of rotifers as a means of identification. In many species, they take the form of toothed forceps that tear the food apart. In others, they act as a grinding mill, and, in still others, as a suction pump. Rotifers of the first sort are active and sometimes prey upon animals of their size or larger. In this case, the rotifer springs upon its prey, suddenly shooting out nipper-like jaws until they project from its mouth, thus enabling it to seize the captive. An example of this is *Dicranophorus forcipatus* (shown on page 506). The second kind, like *Rotaria macrura*, described above, feeds upon very small forms, while those that have suction jaws are herbivorous, feeding upon the contents of plant-cells. For example, *Monommata longisetula* crawls up the filament of *Spirogyra*, cutting a neat round hole in each cell with the tips of its jaws. Then it uses its pumping apparatus to empty by suction the entire



A ROTIFER WITH STRANGE SWIMMING  
ORGANS

*Notommata copeus* extends earlike flaps from its head to use in swimming. They are fringed with moving hairs which draw the animal through the water





A PROTOZOAN COLONY OF BELL-ANIMALCULES (*VORTICELLA CAMPANULA*)

Each individual is anchored by a delicate thread of protoplasm which contracts spirally when the owner is disturbed. Highly magnified strands of pond scum (*Spirogyra*) are conspicuous, spiral chlorophyll structures showing through the transparent, tubular walls. Two strands are forming spores, being connected by ladder-like rungs in the process

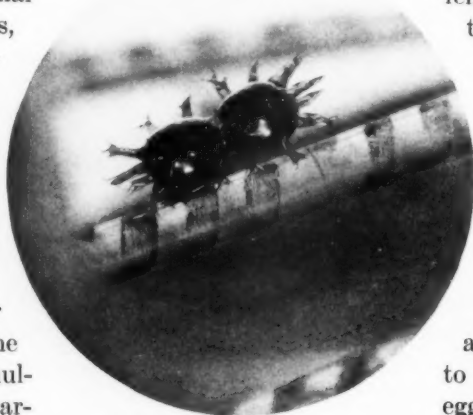
plant cell of its endochrome. It then proceeds to the next cell to repeat the process.

After passing the mastax, the food reaches the large stomach, which is the most conspicuous organ in the rotifer's body. In the group, it is easy to see this organ and all the rest of the internal anatomy of each species, as the animals are clearly transparent. The stomach has a comparatively thick wall composed of a limited number of large cells which are clearly visible in the larger species and give the organ a somewhat mulberry-like appearance. Here, the food is digested, the residue passing out through the short and straight intestine. One urn-shaped species (*Asplanchnopus multiceps*) has a well-developed mouth and pharynx, as well as a large stomach, but there is no intestine present, the indigestible residue of the food being regurgitated through the mouth.

All female rotifers have an ovary situated in front of the base of the stomach. When the eggs are developing, this organ may be so distended as practically to fill the body cavity. The eggs are laid in the water in most cases. Certain species, however, hatch them in the body cavity, the young remaining for a time within the mother's body. Males are very few, compared with the number of females, and are of much smaller size. They have a reproductive apparatus, but no mouth or stomach. They are therefore merely sexual machines which swim about for a few hours

before perishing. During their brief career, some of them justify their existence by pairing with the females. The rest just die. The fertilized eggs last over the winter and hatch out the following spring to give rise to females.

These produce unfertilized eggs which also hatch out females. Thus, during the summer, brood after brood of females are produced, until cold weather sets in during the fall, when male-producing eggs of smaller size are hatched out, making it possible for another sexual mating to give rise to winter eggs, as before.



A MICROSCOPIC WATER PLANT *Xanthidium armatum* is composed of two connected cells armed with spines, which enable it to cling to plant stems

Rotifers have a nerve ganglion, or "brain," in the head region, in close connection with which one or more red eyespots occur. A system

of nerves connects the brain with various parts of the body. They also have paired "kidneys" and a simple muscular system. In short, they are remarkably complex creatures for their small size, and are in sharp contrast to the single-celled protozoa, associated with them in their microscopic environment, which, in some cases exceed them in size.

Thirty-one species of rotifers are shown in the group. This is not unusual in a normal prosperous community found within a cubic half-inch of pond-bottom, under the environmental circumstances represented in the Rotifer Group. A few of the more interesting species will be mentioned.

One of the largest of the rotifers may be seen crawling up a *Spirogyra* filament toward the left of the group. This is



#### A VISTA THROUGH A TANGLE OF POND SCUM (*SPIROGYRA*)

The spiral chlorophyll of *Spirogyra* is clearly visible. A large rotifer (*Notommata copeus*) is crawling up a strand, systematically perforating it, cell by cell, to pump out the chlorophyll for food. A utricle of the bladderwort is capturing a harlequin fly larva, which is struggling to escape. At the lower left an urn rotifer (*Asplanchnopus multiceps*) is seen, with its internal structure showing plainly through its transparent body

*Notommata copeus*. It has the habit of perforating the *Spirogyra* cells and pumping out the endochrome, like *Monommata longiseta*, mentioned above.

At about the center of the group, another *Notommata copeus* is seen swimming. It has a pair of "ear-lappets" extending on either side of its head. These are covered with moving cilia, the rhythmic vibrations of which propel the animal through the water. When it settles on a plant stem to feed, the lappets are drawn in. Just below it is a spherical colony of beautiful rotifers (*Conochilus hippocrepis*) consisting of about twenty-five individuals clinging together by their toes, while the combined motion of their wreaths of cilia causes the whole colony to rotate through the water. Close below the latter, a savage *Dicranophorus* is crouched with its toes resting against a branch of the bladderwort, in readiness to spring upon the next unwary creature that swims by. The utricle near it has apparently forestalled the *Dicranophorus*, for, through the bladder wall, a captured rotifer is dimly seen, vainly trying to find a way out.

Farther down the spray of the bladderwort, an insect larva (that of the harlequin fly, *Chironomus plumosus*) has just been caught by a utricle, and is struggling to escape. The more it struggles, the farther in it goes, for the utricle is lined with glandular hairs pointing inward. Thus, only the muscle contractions in an inward direction are effective. Soon the creature will slip wholly within, and will coil up like its fellow in the bladder farther up the stem, finally to be absorbed by this strange carnivorous plant. How is it possible for a utricle to induce a rotifer or other unsuspecting water animal to come and be caught? By looking at the utricle depicted on page 507, it will be seen that there is a trap door on the lower free corner of the bladder, from the edge of which project long, branched spines. Rotifers

and other small creatures delight to browse among these spines, for small forms of life often adhere to them. In the course of their feeding, they may chance to come in contact with the trap-door. The shorter spines on the upper edge of the door hinder them from easily moving away, and meanwhile the slippery, glandular hairs which cover the surface of the trap cause the victim to slide toward the depression at the upper edge. Here the trap-door is very thin and flexible with a free edge gently held under a curving lip forming that part of the door-frame. As soon as the creature touches this flexible edge, it suddenly gives way and the unhappy explorer drops through the crevice, which immediately closes. The bladder does not digest the rotifer, for no digestive ferment is secreted, as in the case of terrestrial pitcher plants. The animal gradually dies, the fluid products of decay being absorbed by the cell-lining of the utricle, as food for the plant. Water-fleas and protozoa are also captured in this way.

Various species of protozoa are shown in the group. Down at the left, clinging to the base of the bladderwort stem, is a colony of beautiful bell-animalcules (*Vorticella campanula*). These are animals consisting of a single cell each. Superficially they remind one of rotifers, for the bell-shaped body is crowned by a circle of cilia, but the internal organization is that of a protozoan, with a nucleus and contractile vacuoles. Each individual is anchored to the plant by means of a long, slender filament of protoplasm, containing a contractile thread of denser protoplasm. If the animal is touched or otherwise disturbed, the thread contracts, drawing the stem suddenly down to a close spiral, while the bell-shaped body and its ciliated disc contract into a ball. Soon the thread relaxes and the stem slowly lengthens, while the ciliated bell gradually expands and starts beating the water as merrily as ever.





#### A TUBE-BUILDING ROTIFER BUILDS ITS CHIMNEY-LIKE DWELLING

*Floscularia ringens* extends its pansy-like head from the top of its tube and models tiny, spherical bricks of brown mucus with the aid of the finger-shaped projection just back of its head. When finished, these are neatly cemented to the tube margin. The rotifer's home is thus built up like a tiny chimney of the most delicate masonry, resembling fine mosaic

A little to the right of the center is a floating transparent ball, covered with hundreds of tiny green dots, enclosing a number of small dark green spheres. This is a protozoan colony (*Volvox*), often found in fresh water during the spring. The living colony is about half the size of a pin-head, and is very beautiful as it rotates slowly through the water. Each green dot is an individual protozoan, while the small green spheres within are developing *Volvox* embryos. Strange to say, a species of rotifer (*Ascomorpha volvocicola*) lives within the colony, and hatches its eggs there. The young grow and feed within the colony, possibly on the developing *Volvox* embryos, eventually making their escape, only to bore their way into other colonies of *Volvox*.

Perhaps the most beautiful of the rotifers are the flower-like stationary species. A good example is the tube-building rotifer, *Floscularia ringens*. The ciliary wreath of this fairy-like creature extends its petal-shaped lobes, causing it somewhat to resemble a pansy, around the rim of which the extremely delicate cilia vibrate in succession, like a transparent halo of motion. This animal builds a trumpet-shaped chimney to dwell in of tiny spherical bricks of brown mucus, secreted from glands of its body. It spins them into balls one at a time, by means of a hairy, spinning-projection upon its shoulder, and then, with a bob of its head, adds them to the upper rim of the chimney, which thus grows higher and higher. When the young are hatched, they make



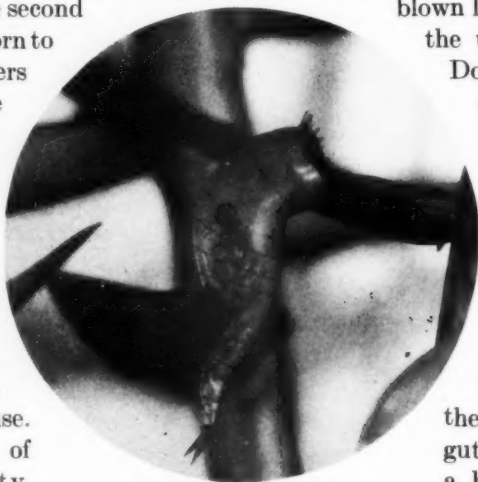
their way out of the tube, and settle down on the outside of the parental mansion, to construct their own homes as additions to it. Soon, quite a branching cluster of these chimneys will be built up. Such a cluster may be seen on the edge of the dead leaf at the bottom of the group.

In the lower right-hand corner, near the branching chimneys of *Floscularia*, are magnificent clusters of two other stationary species. One of these, *Stephanoceros fimbriatus*, has built a double chimney of transparent gelatinous material, and shows one individual retired into its house, while the other extends its graceful head with five curving, fern-like arms out into the water. Fairy-like as this creature may appear, it is a most insatiable animal-trap, for its arms form a net to entangle swimming rotifers or protozoa. These settle down into a funnel-shaped vestibule from the bottom of which a hollow whip extends into a second chamber below. When the victims in the funnel touch the base of the whip, they are suddenly *snapped through its hollow lash* into the second room. Here they are torn to pieces by toothed pincers and conveyed to the stomach. So the fairy, after all, is a most voracious Gorgon!

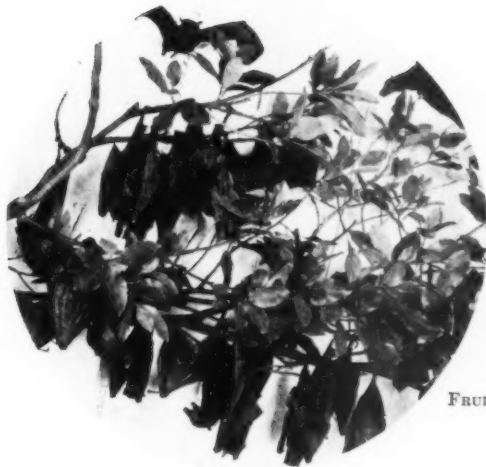
In front of this creature, may be seen a colony of flower-like rotifers, living clustered in a roomy gelatinous house. This is a species of remarkable beauty. Its scientific name is *Octotrocha speciosa*. It was first discovered in China.

Then some years ago, it was found in a pond on Long Island. Later on, Frank J. Myers discovered it abundantly in southern New Jersey, and within, the last few years, both Mr. Myers and the writer found it in ponds on Mount Desert Island. For the most part, it occurs in association with dead oak leaves but, in the latter locality, it was abundant on the water-plant, *Nitella*. How could such a species be of such sporadic and yet wide-spread occurrence? The most probable answer is doubtless the clue to the wide distribution of many rotifers. When pools, in which rotifers occur, dry up, the animals may die or, in case of many individuals, they may go into what is known as "resting stage." The rotifer telescopes into a contracted condition, and stops, with plugs of hardened mucus, any openings through which its small modicum of moisture might evaporate. In such a state, it will resist drying up. Yet, being of the size of a mote, it is easily caught by wind currents and blown long distances through the upper atmosphere.

Doubtless, millions of rotifers, as well as their winter eggs, are sown all over the world by the winds, and, when dropped in favorable localities they dissolve out, come to life, and prosper once more. It is a fact that the dust from a dry rain gutter, on the eaves of a house, will be found prolific in bdelloid rotifers, when placed in a dish of water.



A TYPICAL ROTIFER  
*Cyrtonia tuba* is a top-shaped creature crowned with a wheel-like wreath of cilia



FRUIT BATS

## FLYING SHADOWS OF THE NIGHT

An Account of a Few of the Two Thousand Species and Sub-species of Bats to be Found about the World. Blood-sucking Bats, Fruit-eating Bats, Insectivorous Bats, and Bats That Catch Fish

By G. G. GOODWIN

Assistant, Division of Zoology, American Museum

THE nocturnal habits of the bat and its peculiar appearance have caused it to be looked upon as a weird and uncanny beast. To the mind of the average intelligent person, bats are associated with witchcraft, evil spirits and ill omens; a creature set apart, neither bird nor animal, avoiding the daylight and making its appearance only at dusk, flitting about in the night with noiseless flight. Thousands of people only know the bat as an awful creature that gets into women's hair. Furthermore the wings of the bat have become the emblem of the infernal, and evil spirits are represented in painting with the wings of a bat, as opposed to the dove-like wings adorning the figures of angels.

While the bat has long been considered by the inmates of a house where it entered as a forboding of misery and death, it is looked upon by the Chinese as a most happy omen, and it was consecrated by the ancient Greek to Proserpine.

Bats are true warm-blooded animals, intensely interesting and possessing very

few bad habits. They are the only animals that are capable of actual flight, and in this art they are past masters.

The flying squirrel and flying lemurs are not really entitled to the name. The membranous extension of the skin from the front to the hind feet merely serves to break the fall of the animal as it planes from the top of one tree to the foot of another. For speed, bats compare favorably with some of the fastest birds, and the perfectly controlled flight of the insectivorous bats far surpasses that of any of their feathered allies.

The bat family possesses a great diversity in form and size that is perfectly astounding. There are about 2000 different species and subspecies now recognized in the world, and they range all the way from little insectivorous bats not much larger than a hummingbird to the great fox bats of the South Sea Islands, with a spread of 40 inches.

Some are beautiful, furry little creatures, others are fantastic, their faces fashioned like some complicated flower, and still



Photo by H. E. Anthony

## PROTEST

Angry, squeaking protest at being wakened in bright sunlight

others are most hideous. Nature seems to have been at sport when she fashioned the heads and faces of some of the species, but it is probable that these queer facial expressions, long and peculiar ears, odd, curious noses, are not purely ornamental, and that their uses will in time be found out.

Blainville's flower-nosed bat stands out as one of the most fantastic forms. I took one of these curious little creatures in a cave on Mona Island. A native led the way to the bats about a hundred yards through a winding limestone cave. The bats were hanging from the roof in a small chamber where the air was stagnant and the heat intense. The specimen captured had large ears curiously curled, the chin decked with a highly convoluted bib of skin, and the eyes and nose almost lost in the folds and tubercles of skin that covered the muzzle.

Comparatively little is known about the life history of the bats, and their origin is hidden in the dim ages of the past. They must, however, be a very ancient family judging by the number of species that we have today. Fully developed fossil remains of bats have been found in the

Eocene beds of Europe, hence we know that the first ancestors capable of flight must have lived many millions of years previous.

Bats are sociable and gregarious creatures, but as a rule both sexes do not intermingle, that is to say that in a colony of bats of a given species not a single individual of the female sex will be found, while in another colony not a single male will occur.

Systematists have divided the bats into two great groups, namely the fruit-eating bat, which comprises the largest species, and the insectivorous bat, which contains the greatest number of species, but by far the greater majority of the bats are serviceable to mankind in devouring vast quantities of insects. The only harmful species are some of the fruit bats which are found only in tropical countries, and destroy fruit, and a few that suck the blood of domestic animals. All of the bats found in the United States are both useful and harmless. And in any case their teeth are too small and weak to



Photo by J. P. Chapin

## THE SLEEP DISTURBER

The males of this bat assemble in large flocks and call with resounding loud "pwōkos" at half second intervals from sunset until midnight. For this purpose they have sub-dermal sacs covering the face and a huge ossified larynx that fills half their body cavity

more than puncture the skin of even a child.

The largest of the fruit bats, or flying foxes, are found in the tropical countries of the Old World. Under this category are included the smaller fruit bats of tropical America. The American fruit bats devour many kinds of soft pulpy fruit such as bananas, mangos, etc. At night in the West Indies I have seen trees in an orchard covered with a cloud of fruit bats screaming and fighting over the fruit. Occasionally I have seen them roosting in the daytime, clustered together at the top of a high tree, looking like a huge swarm of bees, but as a rule they prefer a dark or semidark cave in which to spend the day. At St. John's Island, American Virgin Islands, in 1925, I crawled through a small opening into a large dark cave where hundreds of fruit bats were hanging from the roof. It was too dark to see more than a swaying mass above my head, but the noise can only be described as like the rattling of numerous miniature umbrellas. The moment I fired my gun all was confusion, it was as if the whole roof in one dark mass pitched downward and then



Photo by H. E. Anthony

**"MY BACK, THEN"**

The protest against the photographer's intrusion into the privacy of its sleeping quarters

came to life in a thousand whirling forms, churning past me in all directions, and the fluttering of their leathery wings as they billowed around my head was like the wind in the tree tops before a tropical storm. Though the air was so thick with bats that I could knock numbers down with one sweep of my hand, they never collided with one another, and with the exception of a slight touch here and there from the tips of their wings they did not molest me in the least.

All the bats found in the United States are of small or medium size, and they are all insectivorous. One of the commonest species is the beautiful little red bat which appears in the early evening gliding gracefully about up and down the shaded country roads. It can sometimes be found hanging close in amongst the leaves of an oak tree, and at the least sign of danger, it flits silently away to seek another hiding place. The hoary bat is one of the largest and handsomest species found in the Eastern States and is readily distinguished by its dark brown hair tipped with silvery white.

In temperate zones some bats like the red bat and the hoary bat migrate to a



Photo by Herbert Lang

**PIG-HEADED**

The wrinkled-nosed bat was first known to science because its swift flying seemed so impossible to follow that it was a challenge to a gunner

warmer climate when the cold weather comes, but others, such as the common brown bat, may be said to hibernate.

Some bats may be considered carnivorous, like the Asiatic *Megaderma lyra* that is known to feed on frogs and smaller bats than itself. True vampire bats actually do suck the blood of living creatures. They appear to be most abundant in the valley of the Amazon, and where they are common, they do not confine their attacks to domestic animals alone, but will bite a sleeping man at night, usually upon the nose or feet. Fortunately their bite is not poisonous and apart from the loss of a little blood the victim suffers no ill effect.

Probably the most remarkable species

of the whole bat family is the naked bat of Borneo. As its name implies, this bat is hairless, with the exception of a few stiff hairs on its neck. It has a gland or sac under the chin which secretes a substance with a very disagreeable odor. It is probably used like the scent-gland of the skunk, for self protection.

Records of a bat of the genus *Noctilio* catching and eating fish come to us from Trinidad, where it is asserted that this species lives in the caves upon the island of the straits, and comes out in the bright sunlight to prey upon the small fry or minnows which it catches by suddenly swooping down upon the surface of the water

and scooping them up with its hind feet.

The story, however, is not new. Over half a century ago the legend was told by Kingsley in his entertaining book, *At Last: A Christmas in the West Indies*, but although he saw these bats at Mono Island making successive stoops at the water and actually striking the surface of the water, he failed to satisfy himself of the object of their maneuvers, and it was not until many years later that conclusive proof was obtained of the habits attributed to them by the natives of Trinidad.

*Noctilio* is among the very largest of the New World bats and is surpassed, or even equaled, by only one other species in the entire West Indian area. To

give some idea of its appearance, it may be noted that the length from tip to tip is five and a half inches with a wing spread of sixteen inches. The general color is an orange tawny with a yellowish white stripe down the back. The head is large and rounded, with a bulldog-like face.

During a visit to Botany Bay, American Virgin Islands, in May, 1926, I had some interesting experiences with this bat, which was a frequent visitor at a small fresh-water pool at the side of the trail. This water hole was artificial, having been made by herdsmen to water their cattle during the prosperous years of the island. It was the only pool in a radius of about



Photo by Herbert Lang

#### SLUMBER

These bats hang head downward in times of rest, held by their claws securely hooked over a twig. When wrapped between the soft folds of their wings—little can be seen of the khaki-colored fur



three miles, and was about three feet deep in the middle and twenty feet in diameter. One side of it was lined with trees and thick bushes, the other was open to a low plain covered with a luxuriant growth of tropical vegetation teeming with insect life.

Visiting this pond on the evening of May 13 in search of frogs and salamanders, I was surprised to hear several successive loud splashes coming from the middle of the pool. Although it was quite dark I discovered that the disturbance was made by three large bats which were flying back and forth over the plain, and dashing down suddenly as they crossed the water. The night was too dark to see what species they were, but the musky odor in the air peculiar to the bat in question, identified them as *Noctilio*.

Later, when the moon rose, some close-up views of these bats striking the water revealed that at this pond at least they were not fishing. Neither fish nor insect could be seen near the surface of the water before the bats struck, and specimens which were captured immediately afterwards did not have any trace of food in their mouths. The action was too rapid to see exactly what happened. The interfemoral membrane seemed to be stretched out to scoop up the water, and the head thrust forward either in search of food or to drink.

*Noctilio* were usually seen a little after sunset, flying two or three together about ten feet from the ground. They were easily distinguished from the fruit bats by their larger size, steadier flight, and mottled wings. The first arrivals in the



From "British Mammals." Courtesy Longmans Green & Co.

#### THE BAT IN FLIGHT AND AT REST

Thornburn, noted British artist, has successfully depicted a flying bat with tail membrane drawn under to catch the insects

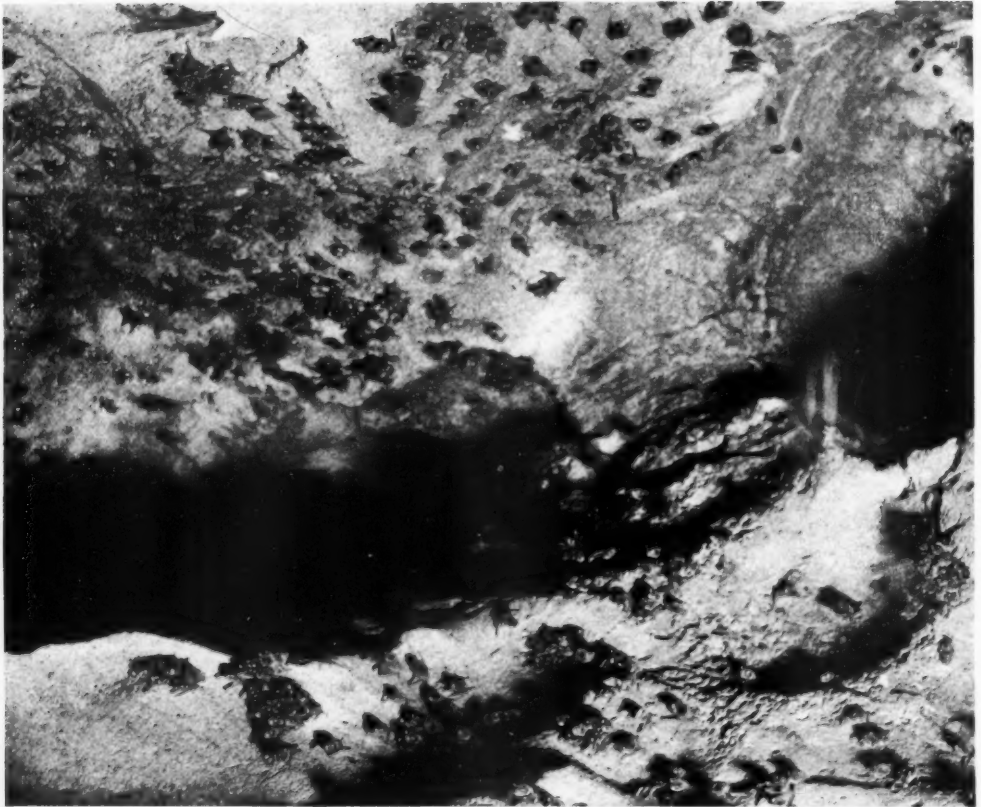


Photo by H. E. Anthony

## SOCIAL AIRMEN

In cave-colonies the bats keep thickly congregated. Note the triangular mass on the upper left wall

evening flew at considerable speed as if coming from a distance, and reminded me more of swallows than of bats. They visited the water regularly at intervals of about twenty minutes. Upon arriving at the pond they made two or three successive splashes and appeared to be drinking rather than fishing. They always hit the surface of the pond near the middle where it was deep, whereas the fish, of which there were plenty, were always seen in shallow water near the sides. Sometimes as they passed me on the way to the pond they made a sharp crunching sound as if grinding the horny parts of a large beetle between their teeth.

An examination of the stomach contents of five specimens of *Noctilio* taken at Botany Bay, showed the remains of insects

exclusively. One hundred per cent fish remains, however, showed in the analysis of the stomach contents of one specimen of *Noctilio* from Trinidad. The most noticeable evidence of these fish remains was the many minute particles of silvery white argenteum of fishes that glittered in the light. The stomach also contained recognizable fragments of fish scales, apparently of an anchovy.

The most extensive records of the fish-eating habits of *Noctilio* seem to come from specimens collected at Mono Island, near Trinidad. Charles Kingsley, writing of his observations of this bat at Mono Island, has the following paragraph: "As it grew dark, dark things came trooping over the sea, by two's and three's, then twenty at a time, all past us toward a

cave near by. Birds we fancied them at first, of the color and size of starlings; but they proved to be bats, and bats, too, which had the reputation of catching fish. So goes the tale believed by some who see them continually, and have a keen eye for nature who say that the bat sweeps the fish up on the top of the water with the scooplike membrane of the hind-legs and tail. For the last fact I will not vouch. But I am assured that fish scales were found, after I left the island, in the stomachs of these bats; and that of fact of the picking up of small fish, there can be no doubt."

Not long after this the story was revived by Dr. G. H. Kingsley, who visited Trinidad during the cruise of the *Northumbria*, and who, like his brother, watched the movements of the bats in question. Under the heading, "Change of Habits in Animals," he published an article in *The Field*, and states that, "On the opposite side of the strait, or Boca, is another cavern which is the roosting place of a colony of large bats, with teeth and wings perfectly fitted for insectivorous feeding. What do they do? Give up insect-hunting, and go a-fishing. They came out in the gloaming, and fluttered and splashed on



Drawing by F. B. Shields

#### FISH-EATING BATS

In Trinidad these bats deserted older insect-catching habits and take their prey of fish by swooping down and scooping up the small surface-living species



Photo by J. P. Chapin

#### THE HAMMER-HEADED BAT

Africa's largest bat, with a wing spread of 40 inches. Entirely frugivorous, this bat restricts its diet to the juices of the fruits it eats

the top of the water, and somehow or other caught tiny fish. I floated about many a hot evening to see how it was done; but, though I was close to them—close enough to be nauseated by their detestable scent—I could never quite make up my mind on the subject. On the whole, I was inclined to accept the native idea that they scoop them off the surface with the interfemoral membrane. However it

was done, they certainly did catch fish and eat them; for I found fish-scales and bones in their stomachs, and had microscopical slides prepared to prove it."

In conclusion, it may be added that *Noctilio* is not the only bat that has been reported to catch fish. So long ago as 1863 Dr. Shortt reported having on two occasions witnessed the big fruit bat of India (*Pteropus*) perform the same feat.



Photo by Herbert Lang

#### ALL EARS

Unlike the other insect catching-bats, this species feeds like a flycatcher and not like a swallow. After each slow foray the bat returns to its tree to eat the insect that was captured



Photo by J. P. Chapin

#### LEAF-NOSED BAT

The peculiar skin configurations this bat bears upon its nose are coupled with acute sensory capacities. Blinded bats flying in a dark room can dodge silk threads suspended from the ceiling



*Photograph by Martin Johnson*

## BIRDS OF AFRICA'S BIG GAME FIELDS

Feathered Residents in the Land of Lions and Zebras. The World's Largest  
and Some of the World's Most Interesting Birds

By JAMES P. CHAPIN

*Associate Curator of Birds of the Eastern Hemisphere, American Museum*

**T**ELL your friends that you are sailing for Mombasa, and they will at once guess that you are off on a big game hunt. But all depends on one's tastes, and whatever these be, they are likely to find some satisfaction on the broad highlands of East Africa. For my part, much as I enjoyed visiting this hunter's paradise, it was certain that most of my time would be occupied with the birds. So possibly I need not describe the herds of hoofed game that we admired from the Kenya and Uganda Railway on that memorable morning when we awoke between Makindu and Simba, and looked off to the southward for the glistening snow-cap of Kilimanjaro.

We had already devoted a week in the vicinity of Mombasa to making the acquaintance of the birds of the coastal belt. During our first evening on the train, in the thirsty thorn-bush country beyond Voi, we continued our studies as best we could, by shining a focussing flashlight from the car window, seeking the reflected beam from the eyes of nocturnal

birds or other creatures. And besides the paired optics of several small carnivores, the more ruddy gleams of goatsuckers' eyes rewarded us a half-dozen times within the space of an hour and a half.

The next morning we saw our first ostriches and kori bustards, the big game among Africa's birds. The ostrich is at once the largest and probably the most primitive of the living birds of our globe, while the kori bustard, more properly a game bird, will weigh up to 30 pounds. A jolting train, however, is not the best place from which to watch birds; and a still more vivid impression was made on my ornithological memory some days later, on our way to the lion country east of Lake Victoria. We awoke in a trader's shack on the dry floor of the Kidong Valley. Looking out at daybreak we found a group of stately marabou storks standing in the short grass, solemn undertakers in white vests, waiting to dispose of carrion from about the neighboring huts. There was at the time a considerable trade in zebra skins, and raw hides hung on the wire fence.





*Photograph by Martin Johnson*

#### CROWNED CRANES

These birds sometimes gather in flocks numbering over fifty. When they have gone to roost at sundown on high trees, they often give utterance to loud, mournful calls, which are accompanied by repeated gruntings

It was clear that they would have to dispute their meal with the crows and ravens that perched on the fence posts, but the marabous' gigantic beaks left little doubt as to the outcome. The attractions for other birds were less clear, but a flock of glossy starlings, cheeping and chattering, shimmered in the rising sun, their steel-green coats extending over the upper chest, but replaced by warm rufous lower down. Equally brilliant sunbirds began to flit about in a natural flower garden near by. Sparrows of unfamiliar color-pattern gathered on the low acacia bushes, while brown-backed Livingstone's chats hopped on the road, or showed a white patch above the tail as they flew to their favorite bush-top. Sweet whistles from the distance were contributed by the streaked brown larks, which in Africa are usually less bubbling with energy than the skylark of Europe.

My eyes could scarce wander off the

birds, but my companions were scanning the open plains, dotted with ant-acacias, in search of larger game. In several directions were grazing herds of hartebeeste and gazelles, here and there a few ostriches, and finally a group of giraffes. To the northeast rose the old volcano of Longonot, to the south its fellow, Mt. Suswa. Scattered about were low hills of jagged lava, and our guide and counselor, Alfred Klein, recounted his adventures with lions discovered by watching from these same hills at the crack of dawn. Sage and Mathews were still enjoying the thrill of the occasion when the other side of the picture was thrust upon us rather brusquely. Up rolled a Ford truck bearing a prostrate form, a man looking far more dead than alive, who had been tossed by a wounded buffalo the day before. He was bound for the hospital in Nairobi.

So on we traveled to the southward,

where the tsetse fly has no terrors for our modern mechanical beasts of burden. The next day we made the acquaintance of the secretary bird, the noisy lesser bustard, guinea-fowl, spur-fowl, tick-birds, and a host of smaller species. But a motor car is only a little better than a railway train for observing birds, and I was happy when we pitched our camp beneath some spreading thorn trees in the Ikoma district of Tanganyika Territory. Even there I chafed at the amount of attention given to big game. Most men have little time for watching birds when the plains are full of wildebeeste, zebra, eland, and all the rest of Nature's live stock. They care naught to follow a honey-guide—never more numerous than here—when lions have been roaring at daybreak, or a bunch of graceful impalla is gazing at them from the open, orchard-like woodlands. It takes a dyed-in-the-wool bird-enthusiast to prefer sport with a

covey of francolins to adding an elegant eland head to his trophies.

Let us banish the mammalian fauna, in so far as possible, and talk birds. Scarcely a step need be taken away from the tents to begin. For a camp must have meat, and before long a white-necked raven discovers this, perching in some neighboring tree, and joined sometimes by the smaller vultures. Several times a day a honey-guide, if not two, would put in appearance and try to lure us off; and at night we frequently heard the reiterated call of a little scops owl. Nocturnal birds in Africa have usually found me readily tempted, but I confess that just here the number of lions we saw by day and heard by night made me rather squeamish about roaming abroad at night, even with the flashlight that is such an aid in discovering the birds. As a result there is still no scops owl in the American Museum from the Ikoma district.



Photograph by Martin Johnson

#### THE WORLD'S LARGEST BIRD

Ostriches will feed and drink in close proximity to large mammals. The cock birds in their black and white dress are far more conspicuous than their gray-brown consorts

In many other places, some even where there were lions, I have had better luck or more courage. An occasional distant roar from a lion did not prevent the hunting of goatsuckers and scops owls in the northern Congo in the old days when we had no focussing flashlight, and sought them at twilight or under the full moon. Later on, when back in the Kidong Valley, we did find the courage to pursue the coveted goatsuckers, and they were by no means so numerous as I had expected.

Once after nightfall I happened upon a pair of secretary birds which had gone to roost in the top of a large thorn tree. They might have been mistaken for vultures save for their long tails, black-banded as seen from below. But these long-legged birds of prey are at their best by day. Even the ostrich is less stately than the secretary, with his martial bearing and deliberate, measured stride, as he stalks alertly over the short-grass plains, or comes to drink at some pool.

Despite his reputation as a snake-hunter—and no doubt some serpents are killed—the greater part of the secretary's fare, in the cases we studied, consisted of large grasshoppers and lizards of several kinds, with only an occasional rat. June in the Kidong Valley must mark the beginning of their breeding season, and we were fortunate enough to find three nests with the old birds sitting on their eggs. They build broad flattish structures of dry sticks and grass-tufts torn up by the roots, which are placed on the tops of small trees or dense clumps of high bushes. Wary in the extreme when on the ground, moving off with such speed that it is almost useless to run after them, the secretary birds behave very differently while incubating. Mathews and I found one nest with more than a score of weaver-birds' nests swinging from the boughs about it, and we walked around under the tree wondering whether or not it could belong to the common augur buzzard.



CAMP IN THE KIDONG VALLEY

In the background are Mt. Longonot (left), and the Kikuyu Escarpment (right)



THE SHORE OF LAKE NAIVASHA

The shallows of this lake are covered by millions of lily pads. Mt. Longonot appears again in the background

Not until I struck the tree a second time did the secretary take wing. Then what a prickly task it proved to climb to where I could see the two bluish-white eggs.

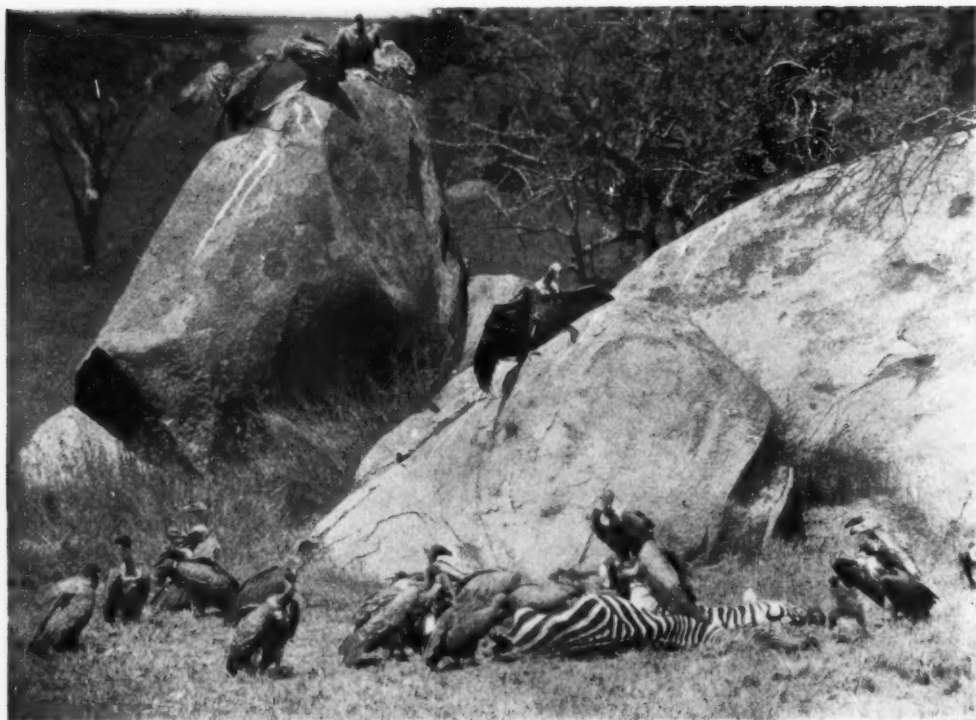
Sage also found a nest by seeing a secretary settle on the top of a thick thorn-tangle. It was most interesting to watch his bird return to the nest. Walking through the fine grass, with cautious glances all about, it approached the base of the bushes supporting its nest, then disappeared as it circled to the far side. This was apparently in order to take advantage of the wind, and a few buoyant strokes of the wings carried it up-wind to its aerie. Soon it settled down so low that only its red face and long middle tail-feathers remained visible. How I longed to stay in the district and watch the up-bringing of little secretaries.

We were a bit early in the season for ostriches. They seemed to have a definite

breeding period, and from April to June we saw none save adults. Males were seen displaying in April near Ikoma, prancing about the female with outspread wings, but I believe that the hens began to lay in the Kidong Valley only after the middle of June. About three months later, Mr. Rockwell tells me that a brood of half a dozen very young ostrich chicks went scurrying along the road ahead of their car, in this same vicinity. The hen remained close at hand, evidently much concerned. While we were there, the adult birds were generally seen in groups of from two to six, the sexes almost invariably mixed, often feeding near grazing herds of antelope or zebra. Like most of the large mammals, they seemed far more wary when approached on foot than when a motor car passed near them.

This Masai Country race of ostrich is said to agree with the North African





*Photograph by A. J. Klein*

#### VULTURES BANQUETING ON A ZEBRA

This picture, which was taken in the Ikoma district of Tanganyika Territory, is typical of the big game fields. Most of these birds are Rüppell's griffon vultures, but an eared vulture can be seen at the right

ostrich in the reddish color of the neck, exhibited by the male in the breeding season. This color in the skin is somewhat obscured by the downy whitish feathering of the neck; but at times, especially when old cocks went running by excitedly, their necks did look pink or even pale red. Silent during the middle of the day, the ostrich nevertheless produces at night or in the early morning a deep call which bears some resemblance to the distant roar of a lion. A newcomer might be deceived, but would soon be set aright by the blacks, who point out that the ostrich roars or "bromms" in groups of three syllables, the second or third syllable being longest. This triple call may be repeated several times, but does not die away gradually like the awesome voice of his majesty Simba.

The ostrich is famed for its propensity

to swallow all manner of hard objects. The most laughable story I have heard in this connection deals with the surprise of an English officer, standing near an enclosure on an ostrich farm, when one of the birds leaned over the fence, plucked a rifle cartridge from a loop on his chest, and promptly swallowed it. As the muscular part of the ostrich stomach usually contains a few handfuls of rounded stones and bits of bone, he may have wondered whether this mill would explode the charge. The hard objects merely aid in grinding the food, which perhaps includes almost anything deemed nutritious, but consists mainly of herbage, grasses and their seed-tops, leaves and pods of small pea-like plants, and leaves and fruit of many others. These often fill the large stomach, which is bent so that the thick-walled pyloric section, with its stones,



lies below and rather in front of the larger portion into which the food is first received.

Ostriches or their near allies once ranged eastward through Asia to Mongolia, but today are restricted to Africa and the deserts of Syria and Arabia. In Africa they are wanting over vast areas of the continent which are too well wooded for their taste. None is ever seen within the limits of the Belgian Congo. Through this partial isolation the northern and southern races have become distinguishable, and there are in addition recognizable subspecies in the Somali Region and the plains of the Masai Country.

In like manner the distribution of vultures in Africa is determined by the nature of the vegetation. Grassy plains and arid regions harbor the greatest numbers of large hoofed animals, and these in turn become food for the vultures. While the forests are not lacking in large mammals,

these would die and go to waste where the forest blanketed them from the keen vision of vultures. Old World vultures find their food by sight, not smell, whereas it seems possible that the American vultures follow their noses to considerable advantage. Thus in forested western Africa only one vulturine species, the black-and-white *Gypohierax*, is truly at home; and it is so little like a typical vulture as to be often regarded as a sort of fishing eagle. Keeping largely to the banks of rivers, it finds dead fish from time to time; but perhaps the greater part of its food, in many regions, consists of the fatty husks of palm-nuts.

On the plain of the Kidong there were six species of vultures, ranging in size from the slender-beaked *Necrosyrtes* and the white Pharaoh's chicken—the latter decidedly scarce—up to the great eared vulture with bare red head. Among those of intermediate size, the white-



Photograph by E. R. Sanborn

Courtesy of the N. Y. Zoological Society

#### A SECRETARY BIRD

It is said that the secretary bird received its name because of the long crest-feathers which, if one will but use his imagination, look like quill pens stuck over a clerk's ear

headed *Trigonoceps* is a striking bird in life, but most abundant were the two griffon vultures, *Gyps rüppellii* and *Pseudogyps africanus*. The griffons often feed together, and are not readily distinguished unless one sees the white patch on the back of the smaller *Pseudogyps*, only shown in flight. The huge eared vulture (*Torgos tracheliotus*) is almost always in the minority.

As the vultures struggle over a carcass, cutting through the eyes and thinnest parts of the skin, the marabous await their turn, and when loose bits of flesh are scattered about by the quarreling vultures, their long-legged companions stride into the busy mob and claim their share in the feast. The speed with which their combined efforts will dispose of a dead animal is astonishing. We met a trader who was collecting zebra hides, this being permitted at the time because of the extreme abundance of these animals. After shooting his zebra, he would have the first cuts for skinning made by a black helper. Then they went on after more zebras, and were followed in two or three hours' time by some black boys with an ox-cart. By that time the vultures had left only the skin and bones, and the crows were picking up the last shreds of flesh. A few cuts with a knife freed the hide from the skull and hoofs, and it was thrown on the cart.

Towards sundown the vultures would gather on the tops of trees, and then

disappear. We found that many of them spent the night in the Njorowa gorge, a few miles to the northward, on shelves high up on the perpendicular cliffs. This gorge attracted us not only because it was frequented by many birds that found the vegetation on the plains too scanty, but because of the boiling springs that issued near the bases of the cliffs. On one of our visits, armed only with shotguns, we had an exciting moment. A sudden commotion in the scrub with violent shaking of small trees was our only warning. Out burst a cow rhino, followed by her calf, headed directly at me. At eight or ten yards she saw me, veered to her left, and then perceived Mathews in her path. Again both rhinos turned and disappeared in the bushes. During seven years of wandering in Africa, an infuriated warthog is the only creature that has ever given me a real charge.

There should have been kori bustards in the Kidong Valley; but we saw none there, and only a single Stanley bustard (*Neotis cafra*). The latter is more richly colored, with considerable rufous on the neck, and cock birds reach a weight of sixteen pounds. I suspect that the numbers of greater bustards, save in the game reserves, have been noticeably reduced by

hunting. But the Kidong had a generous share of the small white-bellied bustards (*Eupodotis canicollis*) and they made their presence known by their loud mournful calls, especially in the



THE WHITE-NECKED RAVEN  
(*CORVULTUR ALBICOLLIS*)

This raven ranges from the native villages in the lowlands up to the most remote spots in the mountains, even close to the snow

morning and late afternoon. As they find ready concealment in the grass, they are sometimes difficult to locate, and occasionally run off silently in the grass. Pairs are the rule, and the male seems to make most of the noise. Even an ornithologist may be forgiven for enjoying a meal of roast bustard. Fine birds they are, with dark red flesh even on the breast.

Now and then, especially at dawn and sundown, the raucous calls of francolins break through the chorus of lesser bird notes. These are partridge-like birds with spurs in the males, and in East

Africa are commonly called "spur-fowl." In the Kidong the harshest "raack-k-k, raack-k-k, . . ." was the voice of the bare-throated *Pternistis leucoscepus*. More retiring, and skulking usually in the scrub along the edges of ravines and about lava boulders, we found *Francolinus hildebrandti*. The male of this bird is heavily spotted with black below, on a whitish ground-color, whereas his consort is plain cinnamon-rufous there. When we recall that the hen of this francolin is exceptional in having spurs, it is not remarkable that the two sexes were long regarded as distinct species. The voice of *hildebrandti* is a confused chattering cackle. Out in the open grassy parts of the plain ran a smaller francolin (*F. hubbardi*) with the plumage on the sides of the head and throat bright cinnamon in the male. It, too, had a very distinctive call, consisting of shrill metallic notes, sometimes

doubled, and repeated again and again.

Along with the francolins live the harlequin quail (*Coturnix delegorguei*), the button-quail (*Turnix sylvatica*), and in many places the helmeted guinea-

fowl, whose voice is so like that of the domestic race. I have often had difficulty in persuading my companions that guinea-fowl were needed for the collection, and were not merely placed on earth to be plucked and dropped into the casserole. The fact is that guinea-fowl differ markedly with the region where they dwell; and while all the forms of *Numida*



MARABOU STORK AND AFRICAN ROOKS  
Together with the vultures, these birds profit from the activities of the lion and of carnivorous man

are little more than geographic races of a single species, there is a large number of such races. They differ mainly in the size and shape of the helmet or casque, colors of the bare face, color and shape of the wattles, presence or absence of "bristles" over the nose, and the coloration of the plumage of the neck and outer webs of the wing-feathers. Reichenow's guinea-fowl, which inhabits this southwestern part of Kenya Colony, is one of those with the longest and straightest helmet. The races with the least development of the casque dwell about the borders of the West African and Congo forests. Within the forests the helmeted guinea-fowl are wholly replaced by the blue-spotted species of the genus *Guttera*, with tufted heads.

The most strikingly colored of guinea-fowls, the vulturine, is not found in the Kidong Valley or adjacent highlands, but in the still drier areas from Somali-

land southward through the Taru Desert. Our first view of it was from the "brake van" of a freight train on the Kenya-Uganda Railway. A flock of perhaps twenty stood alert but motionless in the arid thorn-bush country, within thirty yards of the track, waiting for our long train to finish rumbling by. They make regular visits to water, and their presence will be known from the numerous tracks they leave in sandy spots. How they can run beneath the bushes! Try to follow them, and you find your clothes seized at every move by short, curved thorns.

Dry areas are likewise the favored haunts of sand-grouse. Their resemblance to grouse is superficial, and their strong flight betrays a nearer relationship to the pigeons. On the elevated plains of the Athi, the Masai Reserve, and the Ikoma district we occasionally flushed the large, dark-colored *Pterocles gutturalis* from patches of dry bare earth, while at Tsavo the daintily banded *Pterocles decoratus* came regularly in flocks at about 8:30 A.M. to drink at the river, or even where water overflowed from the tank for the railway engines. During the rest of the day they scattered far and wide, and were seldom seen.

One small bird well known to every hunter in East Africa is the red-billed tick-bird (*Buphagus erythrorhynchus*). Yet it may not be superfluous to mention some of its peculiarities. Finding

its food on the bodies of ungulates, whether wild game or domestic livestock, it climbs about on their smooth hides more actively than a woodpecker on bark. The tips of its curved claws are needle-sharp, and like a woodpecker, it uses its tail as a prop. Now it explores the hair about the opening of an ear, or again hops nimbly sideways to dodge the swish of a tail. Ticks furnish almost the whole of its food, as may be verified from stomach-examinations; but they are supplemented by the animal's flesh and blood if it has a wound or sore. While often protected by law because of its ridding cattle of ticks, the bird may be a source of infection to the animals; and its services are not always appreciated either by native herders or white farmers. The dipping of cattle is a surer and safer means of destroying their ticks.

The tick-bird, like some of the noisy lapwings, is the bane of hunters. It mistrusts mankind, and often gives the alarm as it deserts its lunch-counter and flies off to a distant tree-top. Even where they are accompanying cows I have found them to be decidedly shy and difficult of approach after they have been forced to take wing.

Tick-birds are of two sorts; and whereas the red-billed is the usual

kind in East Africa, the one seen in the grass-lands of the Congo is the so-called yellow-billed species (*B. africanus*). Its beak is thicker, and not entirely yellow,



Photograph by Carl E. Akeley

#### A FLOCK OF FLAMINGOS

Only a small fraction of the flock of which these birds were a part is shown in this view, which was taken on Lake Hannington. Perhaps nowhere else in Africa are these rose-colored birds to be found in such incredible numbers





THE SHORE OF LAKE ELMENTEITA

Showing flamingos standing in the water and flying in the distance, while in the foreground lie the bleaching bones of a hippopotamus

for the distal half is scarlet. Both are essentially similar in habits, and build their nests of dry grass and hair in hollows of trees or buildings. I once found a native boy who took a more romantic view of their home life. To set up house-keeping, he assured me, they sought out an old bull buffalo, and nested in the crevice beneath one of his broad horns.

How can I describe in a few words Nature's attempt to duplicate the humming birds in the Old World tropics? Admittedly the American hummers outclass the sunbirds of Africa in every respect: diminutive size, brilliancy of color, and skill in flight. Yet the sunbirds may take second place among bird jewels. Most of them feed at flowers, partly on nectar, but largely on small insects and spiders. They have long sharp bills, often gracefully curved, and extensile bifid tongues. Glittering metallic colors are largely monopolized by the males, which in a number of species have two lengthened tail-feathers.

Such long-tailed species are most numerous in the highlands of eastern

Africa, and it is not easy to name the most admirable among them. The sickle-billed *Drepanorhynchus reichenowi*, common near Nairobi, has the wings and tail varied with rich yellow. It is often seen clinging to the stalks of the orange-flowered *Leonotis*, probing its deep corolla. Higher on the mountains lives *Nectarinia tacaze*, brilliantly glossed in the male with lilac and bronze, which finds its food partly in the foliage of trees, especially beneath the midribs of the aromatic leaves of *Hagenia*.

Early May, when we climbed to the glaciers of Mt. Kenia, is one of the rainiest periods of the year. After a couple of drizzling days in the mountain forest and bamboos, we emerged in the alpine moorland at about 10,000 feet. Then came patches of sugar-bushes (*Protea*) with gorgeous white flower-heads as big as chrysanthemums. Here for the first time we met *Nectarinia johnstoni*, a large blue-green sunbird with a red tuft beneath each wing. As we ascended farther, the sugar-bushes ceased, and at 13,600 feet the tall stalks of *Lobelia*





*Photograph by A. J. Klein*

#### ON PARADE

In many spots East Africa is a natural zoological park, where fences are needed in order to keep the specimens out—not in. Crowned cranes are among the many charming voluntary exhibits

appeared, clothed with blue-green flowers. These spikes now became the feeding place of Johnston's sunbirds, which we continued to admire up to 15,000 feet, where vegetation began to vanish. Here then was one of the largest forms of the tropical sunbird family, living only in the alpine zone, and flitting about in fog and fine drizzle on the misty heights just below the eternal snows. What a thrill it gave me later, on the Ruwenzori Range and the Kivu volcanoes, to renew my acquaintance with this hardy alpinist, who has found his way from peak to peak, over hundreds of miles of lowlands, until his colonies occupy the pinnacles of tropical Africa from Kilimanjaro and Kenia to the eastern Congo and northern Nyasaland.

Early in July we started from Nairobi on a motor journey to Uganda and the Congo. After crossing the Kikuyu highlands near Limuru the road descends to the floor of the Rift Valley, and follows it to the northward, passing three of the lakes that nestle in this depres-

sion. First we came to Naivasha, a fresh-water lake despite the lack of any visible outlet, about 6000 feet above the sea. Its shores are largely open except for thin groves of acacia trees, which grow especially near the streams emptying into the lake. Elsewhere patches of papyrus, the king of sedges, alternate with lower grassy vegetation; and the shallow water is covered with acre after acre of lily-pads graced with lavender-blue flowers, orange at the center.

On the level fields back from the muddy shores crowned cranes strutted in small groups, and flocks of Egyptian geese came there to feed. The spur-winged geese kept a little nearer to the margin of the lake, while the water's edge was the feeding place of sacred ibises, glossy ibises, white spoonbills, gray herons, egrets, spurred lapwings, ring-plovers, stilts, and jacanas. This last "book-name" is far less descriptive than the East African term, lily-trotter, applied to this peculiar maroon-colored shore-bird, with white throat and golden

gorget, because its long toes and straight thin nails enable it to cross the shallows on the floating vegetation.

Out on the water swam great numbers of dark gray coots, a few crested grebes, and more than a dozen great pelicans, pale salmon-pink in color. White though they seem as stuffed specimens in museums, the large African pelicans are truly pink in life.

Lake Naivasha is justly famous for its waterfowl. Dr. Van Someren has reported thirteen of the seventeen species of East African ducks and geese from this one body of water. Those that attracted our attention were spur-winged geese, on the shore; and out on the water the glossy-backed knob-goose (*Sarkidiornis*), the African pochard, dark in color but related to our red-head, the brown diving duck (*Thalassornis*) with a white spot on its back, African pin-tails, and most numerous of all, the yellow-billed ducks (*Anas undulata*). The last-mentioned are rather like female mallards, and as we neared the water, one of them flew off her downy nest packed with eight buffy eggs.

The picture would not be complete without mention of the flock of thirty or forty gray-headed gulls (*Larus cirrocephalus*), whose favorite station was a muddy bar on the outer fringe of the lily-pad area. This they would quit from time to time to come flying toward us, uttering hoarse "cacks" or a rasping "kra-a-a-h." Near them hovered a few whiskered terns, which seemed to breed there, as no doubt the

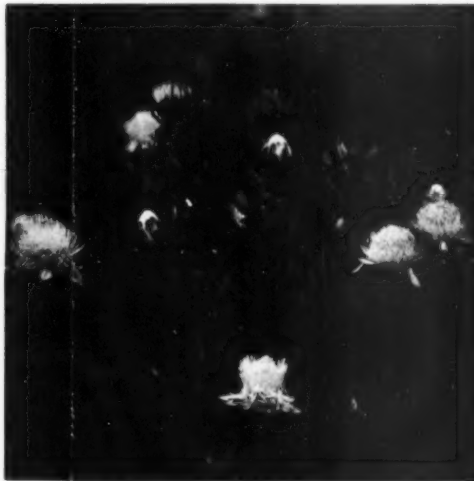
gulls did too. Before we leave this spot, let me include a mite of a red-billed kingfisher with malachite crest, which was seen perching along the edge of the papyrus or shooting along low over the water, as it is indeed on almost every large river or lake which is not surrounded by forest.

Flamingos we failed to find here, though they have been reported; and I began to regret that I should probably not have time to go so far off our road as Lake Hannington, where they are known to dwell in myriads. The next day we were passing the southern end of Lake Elmenteita, and stopped to scan its winding outlines with our glasses. The road was perhaps a quarter of a mile from the shore and a few hundred feet higher. In many places the sandy beaches looked strangely peach-colored, but the nearer shore was screened by the delicate foliage of an acacia wood, and we did not realize what we

were gazing upon till suddenly one of the patches fanned out in a sheet of rose-pink over the blue water. Flamingos!

Down to the shore we went, peering through the trees, and there came upon a flock of over a hundred flamingos standing on a broad muddy beach. The waters of Elmenteita are shallow and markedly salty. Few plants grow

near the water, and the bird fauna is strikingly different from that of Naivasha. Near the flamingos, to be sure, drifted a flock of pochards and eight coots. A very few pelicans swam in the distance,



THE SUNBIRDS' LUNCHEON TABLES  
Sugar-bushes in the alpine zone on Mt. Kenia

and some spurred lapwings and smaller plover ran on the shore. On the other hand, a score of avocets, with awl-like bills bent the wrong way, wandered about in groups of two or three. Their voice was a rather sharp "queek!"

We may be forgiven if we did not notice any other water birds. The lake was far too full of flamingos. The nearest flock saw us and edged into the lake until the water touched their breasts. For a long time they would not fly, or only scattered individuals took wing, soon settling again. Farther along the shore to our left were two more flocks, equally large. Sage busied himself with his motion-picture camera, and many of the birds continued to dip their heads and feed.

The majority of the birds were the lesser flamingo (*Phoeniconaias minor*) of Africa and Northwest India. I had scarcely expected to find the larger species (*Phoenicopterus antiquorum*) here at this season, as it ranges northward to the shores of the Mediterranean, and has been said not to nest in East Africa. Yet there were

many of the larger kind, too, mingling in the same flocks, though outnumbered by the smaller ones in a ratio of 5 to 1. The larger species was readily distinguished by the lighter red coloring of its bill and the more uniform scarlet, rather than rosy, covering of its wings. From the flocks came a hoarse note intermediate between a quack and a honk, but it was impossible to decide

whether this was the voice of only one or of both of the species.

Looking at the bare ground beneath us, close to the water's edge, we saw a long row of flamingo nests, low platforms about seven inches across and only three or four inches high, built of mud scraped up from close about them. Rosy feathers lying on them were those of *Phoeniconaias*, but there were no eggs save one, old and addled, chalky white in color. Perhaps the breeding season was over; but we saw no young, though these have been found on Lake Nakuru in July, October, and November.

Traces of many other nests, much older, were discernible farther back from the water, built perhaps when the level of the lake was higher. Looking toward the far shore, we counted flock after flock lining the lake. From all that we saw here, and while following the road along the eastern side of the lake, we estimated the probable number of flamingos on Elementeita at approximately 8000. This may be far too conservative, but I hesitate to go higher, as some of my



Photograph by E. R. Sanborn

A VULTURINE GUINEA FOWL  
A native of East Africa which was photographed  
in the New York Zoological Park

readers will not be familiar with the likelihood of underestimating birds in flocks.

The flamingo in flight, with neck extended full length and long legs trailing straight behind, the wings beating in slow measure, is like no other bird now alive. The bird-lover as yet unacquainted with it has a thrill left to live for. Had we gone to Lake Hannington, I suppose, my story would have been far

more enthusiastic. Our experience might have been repeated, too, at Lake Nakuru, for as we passed there we noticed pink patches of flamingos scattered all about the shores, numbering perhaps from 5000 to 7000 individuals. But we climbed out of the Rift Valley again on its western side at Eldama Ravine, and made our way to the Uasin Gishu plateau.

We had left Nairobi in dry weather, and were surprised to find the roads across this next plateau deep with sticky mud, still flooded by rains. This difference in rainy seasons doubtless influences the dates of molting of some of the birds. At Nairobi and on the Kikuyu highland, at the end of June, the dancing birds (*Drepanoplectes*

*jacksoni*) had already dropped their long tails and changed from black to brown. Near Eldama Ravine, across the Rift Valley and a little farther north, they were still in black nuptial dress in mid-July, dancing actively over the little circles which the males clip off short amid the grass. The apparent irregularities in the molting of such birds in East Africa may probably be explained by the doubling of the rainy and dry seasons so close to the equator, as well as by local differences in the duration of the rains. In any one locality the molting of birds which periodically change their dress may be expected to show the same regularity as the changes of season.

The panorama of Eastern Africa, as

we crossed from the Indian Ocean to Lake Victoria, interested me not only for its own sake, but also as a contrast to the western half of the continent. Nearing Kitale, close to the base of Mount Elgon, we met for the first time the same species of sugar-bush (*Protea madiensis*) with which Lang

and I had been familiar on the Congo-Sudan border, fourteen years before. As we traveled west from Kitale, with the misty heights of Elgon on our right, the wooded savanna took on the aspect of the northern Congo frontier, with a majority of the trees and bushes seemingly of identical species. Here, as farther west, it was a transition belt. We were fast approaching the area inhabited by plants



A NIGHTJAR

This species is common in Uganda and the grasslands of the Congo, despite its scientific name—*natalensis*. The nightjars are relentless warriors against insects, and go into action every evening about six o'clock

and animals of tropical West Africa. One by one, old friends among the birds, the trees, and even the ants building their roadways across that of modern motor-driving man, made their appearance. It was some six miles west of Malakisi, almost on the political boundary between Kenya Colony and Uganda, that we came to the first small patch of elephant-grass, whose catkin-like spikes might well be chosen as the national flower of Uganda. This giant grass is widely distributed in western Africa, especially near the margins of the great forest. Faunal boundaries are necessarily gradual, but it was not many hours before we were plainly within Western Africa. True forests stretched across our road, and the birds of Uganda



include many West African species.

After a night at a comfortable rest-house—and here at last we secured two scops owls—we went on to Jinja, the thriving town at the outlet of Lake Victoria. For those who care for nothing more exciting, one might recommend the golf course overlooking Ripon Falls. Better yet, one may angle below the swirling waters where the fish pit their skill and courage against the nascent Nile, fighting endlessly to climb the falls. But for me there were still too many birds. Over the falls and over the golf links, at almost every hour of the day, flew parties of large white-throated cormorants on their way between the fishing grounds in the lake and their nesting colonies on the rocky islets amid the rapids. Other cormorants, including the smaller *Phalacrocorax africanus*, swam and dived in the swirling waters, or sat on rocks drying their outspread wings. Here they would be joined by their lankier relatives, the snake-birds, and by little white egrets. Hadadah ibises

mourned vociferously as they flapped past, and marsh-terns beat their course more aimlessly and gracefully over the water, in company with small gray pratincoles, shore-birds that take their insect food on the wing. A brown marsh-harrier sailed in the offing; while on shore large shrikes, scarcely less bloodthirsty, perched in conspicuous spots. Slaty rails and rufous lily-trotters picked their way along the bank, and gleaming little sun-birds flitted through the bushes on the rocky dam over which the falls roared.

As darkness fell, goatsuckers appeared on the open fields, winging their erratic way low over the ground. Most of them were the dull-colored *Caprimulgus natalensis*, widespread in the grasslands throughout Central Africa; but my evening closed with a glimpse of a magnificent male pennant-wing (*Cosmetornis vexillarius*), with large white wing-patches and a long tapering feather flapping out from behind each wing. All but unknown in East Africa, this bird in numbers pays a yearly visit to Uganda and the northern Congo.



THE PENNANT-WINGED NIGHTJAR

As is the case with most of its relatives, including the whippoorwill of the United States, the nightjar is active only when daylight has failed, with the result that it can scarcely be photographed on the wing, but this inverted picture of an individual destined for the collection of the American Museum illustrates the male bird's, unusual form





## THE LEAPING TARPON

One of the Most Spectacular of all Game Fish—A Master of Aërial Acrobatics,  
and a Prize Worth Any Angler's Efforts

By VAN CAMPEN HEILNER

Field Representative, American Museum

PHOTOGRAPHS BY JULIAN A. DIMOCK

THE tarpon (*Tarpon atlanticus*) has often been called the angler's delight. He is one of the world's best known and spectacular fishes. His stuffed skin adorns the walls of countless clubs and sportsman's retreats and his portrait in oils has graced the cover of many a magazine. Though few realize it, to him is due no small amount of credit for the development of Florida, yet he is by no means confined to that peninsula, the world's record having been taken in Mexico.

Largest of the herring tribe, the tarpon is more or less common from Long Island (summer) to Brazil. Occasional tarpon wander north along the Atlantic seaboard every summer and are frequently caught in nets; infrequently by anglers. At Hatteras, North Carolina, the fish seem to be more or less plentiful throughout all the warm months. While the writer has seen and caught very small tarpon up the rivers of the west coast of Florida, it is rather doubtful if they breed north of Cuba, or if so, rarely.

Tarpon are eagerly sought after wherever they occur. As a food fish they

leave much to be desired, but as spectacular sport, when taken on the proper tackle, they have few equals. The majority of the tarpon clubs are in Florida, though there are some in Texas and Mexico, to say nothing of the famous club on the Atlantic side of the Panama Canal. Here, where the great Gatun Dam spans the Chagres River, is to be found some of the finest tarpon fishing extant. I am under the impression that an attempt was made at one time to tow a "live-car" full of tarpon from the Atlantic through the Canal into the Pacific but, so far as I know, nothing ever came of it. I see no reason why the tarpon should not flourish in the Pacific notably on the west coast of Central America. Other fish have been transplanted from the Atlantic to the Pacific with success, notably the striped bass (*Roccus lineatus*) from the Shrewsbury River, N. J., about 1870 to California, where it is now more abundant than on the Atlantic Coast.

The tarpon loves to frequent passes, channels, and cuts through the banks. Here he lies in wait for whatever small fishes the various tides will bring him.



A LEAPING TARPON OF BOCA GRANDE, FLORIDA

One can faintly trace the course of the line and can understand how the violent contortions of the fish are frequently successful in dislodging the hook

He can be caught either trolling or still fishing and the writer has taken young tarpon on salmon flies. In trolling, a baited hook or artificial bait is trolled slowly from a launch or skiff back and forth through the passes known to be used by the fish. In still fishing, a hook baited with crab or cut bait is lowered to the bottom and sufficient time given the tarpon to swallow the bait before setting the hook. The instant the fish feels the barb he rushes to the surface and hurls himself into the air in an amazing and sensational series of leaps in a frequently successful effort to free himself. So violent and furious are these jumps that the fish soon exhausts himself and, if he has not broken loose, can be soon brought to boat. There are, however, exceptions to this rule. One of the largest tarpon of which I know, taken by Mr. Schutt of the Long Key (Florida) Fishing Camp, jumped only once dur-

ing the entire fight. At the end, as the fish was almost to boat, a large shark rushed up and bit it in two just behind the dorsal fin. The part remaining, which weighed over two hundred pounds is mounted and hangs in the Long Key Camp today.

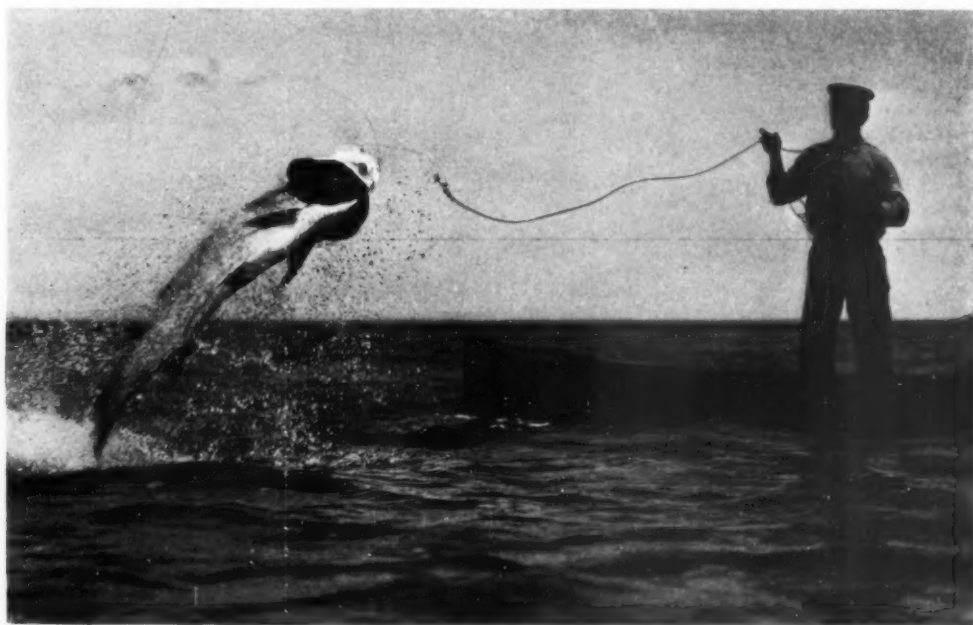
In Florida, the best tarpon fishing occurs in May and June. Earlier in the season the fish are frequently caught along the viaducts of the oversea railroad, but at that time of year they seem to bite best at night. I have seen the tarpon around Cape Sable lying all over the flats and banks like shoals of bait, and I know of a harbor mouth in the Bahamas where at all times vast numbers of tarpon of thirty to fifty pounds weight may be seen through a water-glass lying on the bottom as thick as sardines in a can. "For ways that are dark and tricks that are vain" the tarpon is very peculiar. Sometimes where you expect to meet him, you don't, and vice versa.

I first became interested in the tarpon through the enthusiasm of my dear friend Mr. Anthony W. Dimock, father of Julian Dimock who took the photographs accompanying this article. No such photographs have ever been made since and probably never will be again. It was a happy combination of a great sportsman and a great photographer. Mr. Julian Dimock very kindly presented all his plates to the American Museum of Natural History where they portray for all time a pictorial history of this wonderful game fish.

My first tarpon weighed only twenty pounds but he might just as well have weighed two hundred so far as my sensations were concerned. The circumstances remain engraved upon my memory. A moonlight night, the ghostly arches of the viaduct, the put-put of the tiny launch that carried me crosswise to the rushing tide; then the strike, and the flash of silver, dripping diamonds

of spray from its flanks, that catapulted itself into the air again and again, and yet again. A lot of water has flowed through those arches since that time and many have been the tarpon that have leaped at the end of my line, but that one can never be erased from my memory.

I remember one blazing hot day toward the end of March on the vast miles of banks off the southern tip of Florida. The tide had turned at about three in the afternoon and all along the great shoal from Sandy Key eastward to Snake Bight tarpon were leaping. The mullet were "in" and the water was discolored a milky white. As we slid across the flats in our little skiff propelled by an outboard motor we could see the long plumes of tarpon wavering for an instant on the surface. The sun set in a great ball of red fire as we started up a long blue-green channel that wound between the banks. I was fishing with an extra-light outfit



A FIGHTER OF CAPTIVA PASS, FLORIDA

This photograph shows the relatively, as well as actually, large gills of the tarpon. It is the gills that supply the oxygen that is necessary to the life of the fish, and the exceptional size of the gills in these fish makes possible their tremendous activity



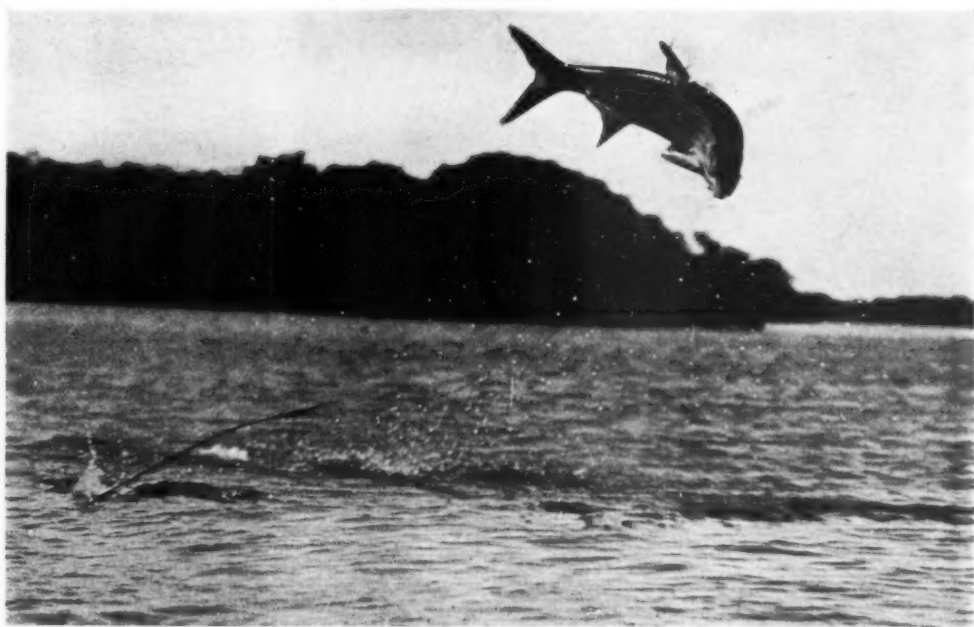
#### A STRUGGLE ON A FLORIDA RIVER

When the fish feels the barb and hurls itself into the air, the angler needs all his quickness of thought and action in order to prevent the hook from being dislodged



#### A FIERCE FIGHTER ON AN INLET OF THE FLORIDA COAST

The violent struggles of the leaping tarpon, as recorded by the camera, show contortions of which one would not think the fish's body capable



**A LEAPING TARPON AT MARCO, FLORIDA**

This unusual picture shows clearly the graceful form and the powerful tail fin of the tarpon. At the lower left the line is also visible



**ANOTHER TARPON TAKEN ON A FLORIDA RIVER**

These leaping fish occasionally turn complete somersaults in the air. Evidently this occurred when the above picture was obtained





## ANOTHER FIGHTER OF BOCA GRANDE

None of these photographs show the elongated hind ray of the back fin which is characteristic of this species, for it lies close to the back

made especially for me by James Heddon's Sons, the great Michigan rod makers, a rod that weighed only four and a half ounces and was more suitable for fresh water than for tarpon.

We came to the end of the channel and turned to retrace our wake. Suddenly there was a swift surge on my line and into the air bounded a tarpon. I could hear the tinkle of the spoon as he wrestled his head from side to side in an effort to dislodge it. But it held, and this seemed to increase his frenzy, for he was in and out of the water so fast that one wondered if I were fast to some great sea bird or a fish that preferred air to its natural element. The skiff drifted with the tide and the fish continued its mad leaping. Half the time I did not know whether I had him on or not. But then the line would straighten out and the dead weight would come at the end and I knew the fight was not yet finished. The tackle was so light that I could not easily force the fighting and it was over a half hour before I had him alongside.

He was nearly dead, worn out from his terrific exertions. We tipped the skiff down on one side and slid him over

the edge. Back at the cruiser he weighed fifty-six pounds and today he hangs mounted on the walls of my studio, one of my proudest achievements with rod and line. For thrills aplenty try the Silver King on bait casting tackle!

I remember another day in late May on the West Coast. We were still-fishing in a pass. Tarpon had been rolling all around us some time previously but we could not get them to bite. I was drowsing in my seat at the stern of the skiff when I suddenly noticed the line, which I had stripped from my reel and laid on one of the thwarts, start to uncoil and slide over the edge into the sea. For several seconds I watched it as if fascinated; then when it had almost reached the end, I let it come taut and struck, once—twice. Almost immediately a tarpon shot skyward astern and a little to one side, and the battle was on. From then on the tarpon bit at anything and everything offered, and we landed seven.

So it goes. A friend, B. W. Crowninshield, landed over twenty-five tarpon between sunup and sundown at Boca Grande, a famous resort of these great fish. Tarpon as a rule run from thirty

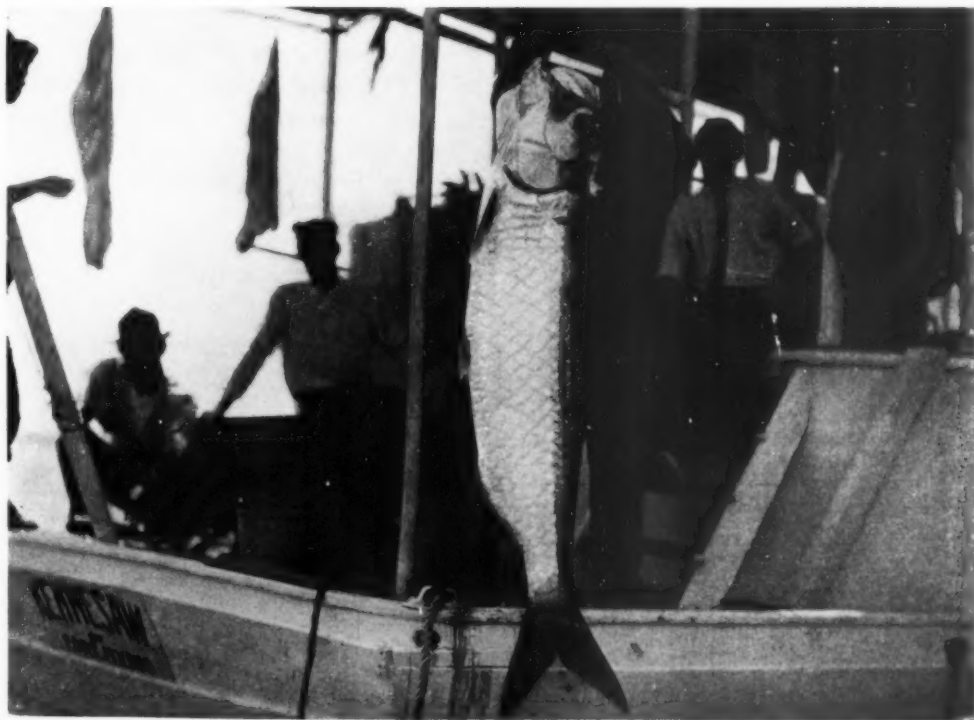
to eighty pounds. Many are caught from one hundred and twenty to one hundred and seventy and these are large fish. Over two hundred pounds is exceptional. The world's record tarpon on rod and reel was taken by W. A. McLaren in the Panuco River, Mexico, and weighed two hundred and thirty-two pounds. We have a mounted tarpon in the American Museum, details of capture unknown, which from appearance must have run close to three hundred pounds. This I should think is about the limit.

Tarpon probably spawn somewhere in the Caribbean, possibly up fresh-water rivers from which they descend to the sea and wander all over. I have always felt that some must spawn up the fresh-water rivers of the west coast of Florida, for I have seen countless baby tarpon in them, but have never received

actual proof of it.

There is no doubt that the majority of tarpon seen run from thirty to eighty pounds. Where the big ones are is a question. It occurs to the writer that as the tarpon grow older and larger they lose some of their agility and fall a more easy prey to sharks. Of course there are plenty of big tarpon still left, but the smaller ones outnumber them five and six to one, and the shark theory is at least plausible.

If you are one who loves angling, pack your tackle and make your plans next spring to slip down the coast to Florida or Texas or Panama or to the countless other places that fringe the Caribbean and try your mettle on one of the grandest of God's gifts to fishermen, that molten ball of flashing, gleaming silver, that master of aerial acrobatics, the leaping tarpon.



A PRIZE TAKEN NEAR FORT MYERS, FLORIDA

The tarpon, which is the largest of the herring tribe, sometimes reaches a weight of between two and three hundred pounds



## LIFE IN MINIATURE

How Wax Models Are Made and How They Are Used in  
Museums to Portray Many Phases of Natural History

By EDWARD J. BURNS  
Preparator, American Museum

ILLUSTRATED WITH PHOTOGRAPHS OF MODELS CONSTRUCTED BY THE AUTHOR

THE museum visitor of today is invariably impressed by the life-like beauty of the flowers and plants reproduced in the various habitat groups, and marvels at the effective realism of the wax models showing the various forms of animal life. People frequently ask the question, "How long has wax-working been in use?" and many are surprised to learn that it is among the most ancient and widely practiced of the minor arts.

Down through the centuries of civilized art in every country we find it valued, often meeting with its use even among primitive peoples. The Maori of New Zealand model creditable medallions in wax, while there is good evidence that the ancient peoples of Central America and Peru were aware of its value and employed it extensively in the *cire perdue* process, an ingenious method of casting gold ornaments from wax models.

While beeswax itself is one of the more durable of organic substances when given ordinary care, as is attested by perfectly preserved specimens from the Fifteenth Century to be seen in many museums, it is indeed unfortunate that it cannot withstand being buried for as long a time as other materials; otherwise our collections of the art work of ancient peoples would no doubt be enriched by many beautiful objects rivaling their work in stone and metal.

Frequent references to the wax images of the gods occur in Egyptian and Persian records. In the days of Alexander the Great, the Greeks brought the use of beeswax in modeling and casting to such a high degree of perfection that the wax workers rivaled the sculptors in the life-like portraits they modeled and colored. Wax portrait masks of ancestors graced the atria of patrician homes during the Roman ascendancy. In this period it was also the custom to carry a wax effigy

of the recently departed at the head of the funeral procession—an exclusive privilege of the nobility and a custom of which remnants are to be found even today in religious ceremonies in Italy. In England an elaborately robed figure in colored waxes of Queen Elizabeth made at the time of her death, is one of the treasures of Westminster Abbey.

We read an interesting account in the autobiography of Benvenuto Cellini of his use of wax in casting the Medusa of his *Perseus*. Many miniatures in this material are known to have been made by this versatile genius and by most of the other prominent masters of his period. Michelangelo used it extensively in preparing models for his larger groups and also as the final medium for smaller works. A portrait medallion of Michelangelo by his friend Leone Leoni, still preserved in the British Museum,

owes much of its rare beauty to the working qualities of wax.

During the periods following the Italian Renaissance the use of this material was not extensive until the time of Louis XIV and his immediate successors, when elaborately decorated wax miniatures were extremely popular.

For the past century the high excellence of the art has been maintained only by isolated artists specializing in medallions, notably the later English and French, who also have left us an interesting technique akin to cameo cutting. This process consisted of flowing a thin layer of light colored wax over a smooth, flat slab of the same material in a darker tone. Into this thin layer the figures desired were modeled in low relief, and the effect of transparent drapery was achieved by working down to the darker surface. The charming results obtained



A MANDAN WOMAN WITH A BULL-BOAT

This unusual boat is merely a round frame covered with buffalo hides. The Mandans, who lived near the Missouri River, used these boats on that stream and its tributaries, but obviously it does not compare in efficiency with the more graceful birch-bark canoes of other Indians



BLACKFOOT INDIAN WOMAN AND GIRL

This model group was constructed in order to show the uses of the travois, which was common among the Plains Indians before the coming of the white man. Prior to the introduction of the horse to North America by the Spaniards, the only beasts of burden known to the Plains Indians were their dogs, and small travois were made in order that the dogs might be loaded with small parcels. Once the horse became common, the travois was adapted to his size

by this method rival the excellent work done by the cameo cutters on Madagascar helmet shells, some fine examples of which are to be seen in the Morgan Gem Hall of the American Museum.

Numerous formulæ, some of which have unfortunately been lost, have been devised in the past to render the beeswax more opaque or translucent, harder or softer to meet the special requirements of the work to be done. A number of the waxes used by the early Italian workers were darker and more dense than those used at a later period, frequently approaching marble in hardness and fineness of texture. We learn that Vasari recommended "to render softer, a little animal fat and turpentine and black pitch are put into the wax, and of these ingredients it is the fat that makes it more supple, the turpentine adds tenacity

and the pitch gives it a black color and consistency so that after it has been worked and left to stand it will become hard."

The development of exhibition work in the museum of today has increased the interest in the ready responsiveness of wax as a medium in producing life-like exhibits of all living things. Its permanence as well as the facility with which its density may be controlled gives it first place in duplicating complicated form, colors, and textures.

Although some workers prefer to model directly in wax, it has been the writer's experience that better results are obtained when making miniature groups by first modeling the figure in plastelene, then making a plaster mould over it, and, after removing the plastelene, pouring in the melted wax which has pre-



viously been colored to the proper body tone. This preliminary modeling allows greater freedom in composing the figure and the subsequent casting gives a more durable and a cleaner surface than is obtained by laying on the wax bit by bit over the armature. The uneven texture and soot stains from the heated tools used in laying on the wax are thus avoided, and the development of the various delicate tones necessary to produce a lifelike effect is made possible.

A good example of the method of procedure in preparing a miniature may be found in the Blackfoot travois model recently added to the now complete synoptic exhibit in the Eastern Woodland Indian Hall, planned by the late Dr. Pliny E. Goddard to illustrate the

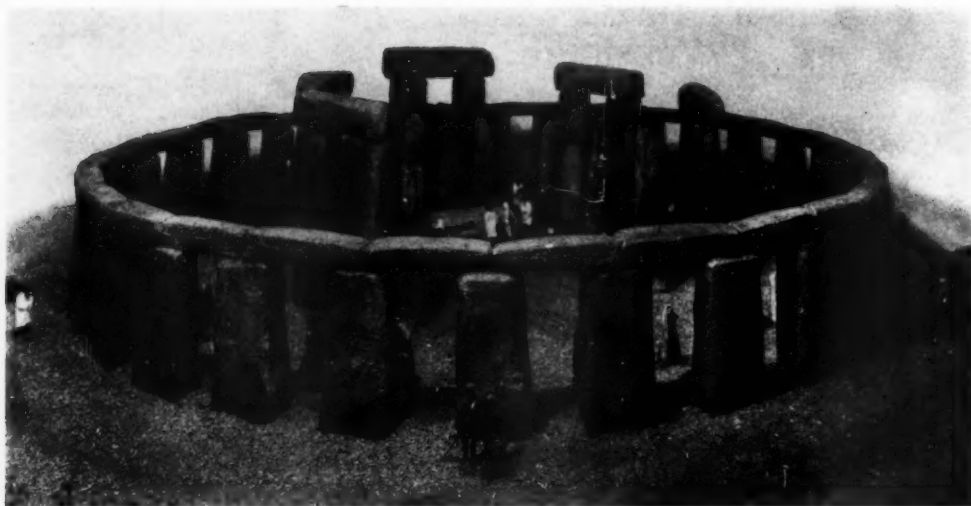
various types of native culture in North America.

This group, which was designed to show the typical Plains Indian method of transportation, consists first of a Blackfoot woman astride a pony dragging a travois. From the pommel of the saddle a cradle board is suspended. Somewhat ahead of the pony a girl, carrying an armful of puppies, is walking beside a dog dragging a smaller travois. In making such a miniature group it is necessary, before starting the actual modeling, to study carefully all the literature available on the subject to be portrayed and to examine and measure the actual costumes, weapons, utensils, etc., wherever possible to insure the absolute accuracy of every detail, without which the



MR. BURNS COMPLETING THE TRAVOIS MODEL

Most of the models shown in these illustrations are made on a scale of two inches to the foot. Thus a man six feet tall would be reproduced in a model twelve inches high. The figures are all cast in wax, but many other materials are required for the accessories



STONEHENGE—RECONSTRUCTED

This type of model is particularly valuable in reconstructions of ancient ruins. Huge structures can sometimes be modeled in great detail but at comparatively small expense, as this ancient English ruin has been, and can be exhibited without utilizing much space. The original circle of stones is here reproduced on a scale of one quarter inch to one foot, and this model is now on display at the Children's Museum of Detroit

group would be of no scientific value.

The object being to tell a complete story of primitive transportation on the Plains, it was decided to include the dog travois in the same group with the horse in order to bring out the fact that both animals were used to drag loads. The dog was placed before the horse to call attention to the fact that dogs were used for this purpose before the horses were introduced into America by the Spaniards, and also to show that the larger framework pulled by the horse was evolved from the one designed for the dog. The woman riding and the baby on the cradle board carried suspended from the saddle help to complete the story of the methods of travel.

Before the modeling of the figures was started, measurements were made for all the objects to be used. The height and size of the woman were worked out from average measurements of this particular tribe. The average proportions of Indian dogs and ponies, just as important, were not so easily obtained. The dimensions of

actual museum specimens of cradle board, saddle, bridle, quirt, and travois were determined and the whole brought down to the working scale of the group, two inches to a foot. The patterns of original costumes were also studied to assist in the proper draping of the figures, and attention was given to the methods of harnessing the travois poles to the animals. After all this data had been arranged, the modeling of the figures proceeded to completion, and after the wax casts were made, the various textures and colors of skin, hair, and leather were worked on. The beadwork designs were copied directly from actual specimens. The various parts of the group were then assembled. While the greater part of the model involved wax technique, for accurate reproduction some of the minor details required a variety of materials. So, just as the medallions of long ago were enhanced by actual small jewels and gold work, the silver ornaments on the woman's belt were cut from burnished aluminum, the saddle horn, cradle board, and stirrups

were carved in wood, and the harness and travois lashings were made from fine leather and rawhide.

The preceding details merely cover the main problems of construction. Numerous minor problems presented themselves, such as the selection of miniature travois poles. Most twigs appear too crooked when the bark is removed and taper too rapidly to duplicate the actual large poles of the travois. Numerous types of woods were examined and the upright shoots of maple-leaved viburnum were found to answer the purpose, for while a makeshift might have been used, the attention to small details of this kind helps to make the finished group more convincing.

Some interesting and often amusing side-lights on model making come up in the search for material suitable for the miniature reproduction of accessories. Often mere chance will produce the desired object. For example, miniature

sagebrush was needed for several of the groups of the Plains Indians. It is doubtful whether sagebrush growing in clumps three inches high could ever be found, while the nature of the plant makes it difficult to model artificially. Having this need in mind, the writer while on a trip to Maine was quite fortunate in chancing upon a field covered with a low growth of reindeer lichen (*Cladonia*). Its resemblance to sagebrush was at once apparent and a quantity was brought back to the Museum where, after being treated with a preservative, it was arranged on artificial stems and colored from a sample of the real sagebrush with satisfactory results. On one occasion, the headdress of eagle feathers worn by a Sioux chief was reproduced by canary feathers bleached white and dyed brown at the tips; at another time the clothing of Eskimos was reproduced by using the fur of small rodents. The peculiar color and quality of the arctic fox was ob-



A TYPICAL HOPI PUEBLO

Due to the problem of size, this type of structure obviously can be completely shown in museums only by the use of photographs and models. In the foreground is shown the communal ovens, and the circular fence protects the entrance to the *kiva*, or underground club room, from which women and children are excluded



#### AN ESKIMO IN HIS KAYAK

This hunter is shown fully equipped for the pursuit of seals. Not only were the weapons tipped with ivory, which was commonly in use before the advent of the white man, but both ends of the kayak were also protected with strips of ivory to prevent damage



#### AN ESKIMO SNOW HOUSE

The winter dwelling common within the Arctic Circle. Among the natives of America the use of the arch was utterly unknown except as it was employed by the Eskimos in these snow houses



#### A BEAVER INDIAN ON THE TRAIL

This native of the Hudson Bay country is shown as he was shortly after the settlement of Canada by the whites. His toboggan is the original type from which has sprung the toboggan now so commonly used in sport



#### A SMITH SOUND ESKIMO WITH HIS DOGS

The Eskimos of the eastern portion of Arctic America harness their dogs as shown here. In Alaska and northwestern Canada the dogs are harnessed in tandem





**KWAKIUTL INDIANS IN A  
DUGOUT CANOE**

These Indians are typical of the Northwest American Coast region, and are remarkably adept at wood carving

tained by washing the skins of white mice repeatedly with weak dyes until the proper tone was reached.

Frequently the task of designing a model becomes more difficult when the people to be portrayed are extinct and few of their costumes and utensils are in existence. The Indians of Manhattan Island furnish a good example of this. Making a group illustrating their customs requires a careful study of the writings of the early Dutch settlers for information concerning them, and a checking up with the known facts regarding adjoining tribes still living who



may have influenced the people in question. In fact, preparing an exhibit of our Indians may often involve some of the difficulties encountered in modeling a group of prehistoric man.

These new problems, which are continually coming up, afford one of the most fascinating aspects of model work, while the ever increasing need in our modern museums for concise and realistic exhibits portraying the history of man and his achievements, offers a limitless field for the future development of this ancient art which owes much of its charm to that wonderful gift of nature—beeswax.

**A SIOUX INDIAN  
WARRIOR**

In full ceremonial costume. The face was modeled from a life cast in the American Museum collections

## NOTES

### THE INTERNATIONAL CONGRESS OF AMERICANISTS

As announced in the previous issue of *NATURAL HISTORY*, the American Museum during the week of September 17 acts the part of principal host to an old and distinguished body of scientists, namely, the International Congress of Americanists. Since its organization in 1875, under quasi-governmental auspices, this Congress has held sessions—international relations permitting—every two years. During the present century, the sittings have alternated between Europe and the New World, and this is the third session in the United States and the second to be held at the American Museum. Henry Fairfield Osborn, president of the American Museum of Natural History and president of the American Association for the Advancement of Science, is chairman of the honorary committee of the XXIII Congress of Americanists.

The local Organizing Committee includes: Chairman, Franz Boas of Columbia University; Treasurer, George G. Heye of the Museum of the American Indian (Heye Foundation); and Secretary, the late Pliny Earl Goddard of the American Museum. Other members on the Committee are Stewart Culin of the Brooklyn Museum and A. V. Kidder of the Carnegie Institution, Washington, D.C. Since Doctor Goddard's death most of the organization work has fallen on the shoulders of Professor Boas, N. C. Nelson of the American Museum assisting in the capacity of Secretary pro tem.

The formal opening of the Congress takes place at 12 noon on Monday, September 17, with greetings by Mayor Walker, Honorary Chairman Osborn, and others. The first general session begins at 2:30 P.M. the same day and is followed at 8:30 by a reception by the President and Trustees of the American Museum of Natural History. The Tuesday sessions, both general and sectional, begin at 9:30 A.M. and 2:30 P.M. respectively, and the day's program closes at 8:30 P.M. with illustrated lectures on the Maya by Sylvanus G. Morley and Frans Blom. The Wednesday sessions are to be held at the Museum of the American Indian (Heye Foundation) and the American Geographical Society, 155th St. and Broadway, beginning at 9:30 A.M. On Thursday a forenoon session will be held at Columbia University, the afternoon being devoted to a boat excursion to Garrison-on-Hudson and a reception by President and Mrs. Henry Fairfield Osborn at their summer residence. The Friday

sessions commence at 10 A.M. at the Brooklyn Museum and end with a lawn party at Glen Cove at 4 P.M. Saturday, September 22, sees the finish of the program at the American Museum of Natural History, with a general session at 9:30 A.M. and the closing session at 12 noon.

To date this XXIII Congress has a signed up membership of about 200, fully one half of which is from foreign countries. The papers submitted for the program number nearly 125, covering almost every phase of the problem presented by the aboriginal peoples of the American continent.

### ASTRONOMY

THE FIRST FALL MEETING OF THE AMATEUR ASTRONOMERS ASSOCIATION will be held at 8:15 P.M. on WEDNESDAY EVENING, September 19, 1928, at the American Museum of Natural History.

A cordial invitation is extended to all the members of the Museum, as well as to all amateur and professional astronomers, to take advantage of the rare opportunity offered by this Association to participate in the study of astronomy by non-technical methods and to develop its cultural and inspirational value.

At this first meeting of the new season, it is hoped that those members who have carried on interesting astronomical observations during the summer will tell of their experiences and progress.

Special attention is called to the fact that the meeting nights have been changed to the FIRST AND THIRD WEDNESDAYS of each month.

Many prominent astronomers have already offered to address the meetings during the winter, and the Association is looking forward to full and varied programs, treating astronomy from every angle interesting to the amateur.

### EXPEDITIONS

CENTRAL ASIATIC EXPEDITION.—The safe return to Peking of Doctor Andrews' entire party with a mass of palaeontologic treasure after a five-thousand-mile expedition in Mongolia has brought rejoicing that he has again triumphed over the manifold obstacles of human and inanimate nature, and has brought his fifth Asiatic expedition to so successful a conclusion.

On August 16 Doctor Andrews cabled:

Expedition return. Well. Travels five thousand miles. Explores, maps much new country. Discovers new geological formations, fossil deposits. Finds residence sites Dune Dwellers, culture everywhere, yielding thousands stone implements, decorated bones, shells, tooth necklace, indicating that twenty thousand years ago Mongolia more densely populated than today. Have ninety cases fossils. Two skulls, many bones, skeleton of gigantic new mammal, possibly larger than *Baluchitherium*, humerus big as man's

body, new phylum. Huge Titanotheres, extraordinary saddle-like skull. New Mastodon, spatulate jaw, lower incisors, eighteen inches wide. We consider extremely successful expedition. Unprecedented leakage gasoline forced early return.—ANDREWS.

The principal archaeological discoveries for the season appear to have been made at Erhlien, a locality situated on the eastern border of the Gobi desert proper, not far from the Kalgan-Urga road. Ancient dried-up lakes mentioned at this place once furnished conditions suitable for the life of early man, similar to those found in 1925 to have formerly obtained at Shabarakh Usu and elsewhere on the western border of the Gobi. Fortunately, the finds this year, if not numerically richer than formerly, are more varied, yielding bone implements and ornaments as well as objects of stone, shell, and pottery. The culture is again that of the "Dune Dwellers," which now it will be possible to describe in much greater detail.

"Ninety cases of fossils" are magic words to palaeontologists. The new mammal "possibly larger than *Baluchitherium*," with a humerus as big as a man's body, would be enough of reward for any ordinary expedition; but the huge titanotheres with extraordinary saddle-like skull piles Ossa on Pelion; and the new mastodon with the spatulate jaw will soon be adorning the monograph on the Proboscidea by Professor Osborn.

Of course we may think of the still bigger fossils that they might have found if the gasoline leak had not forced so early a return, but prudent folk will be glad that they cashed in on their luck when they did.

THE STOLL-McCRACKEN SIBERIAN ARCTIC EXPEDITION is frequently heard from by wireless messages to the press. According to these reports, the "Morrissey" stopped at Chickagof Island where four Sitka deer were secured. From May 28 to June 20 they hunted on the Alaskan Peninsula for bear. Between forty and fifty bear were seen by the party, and nine of these were taken. A number of Grant's caribou were also added to the collections. Near Teller, Captain Bartlett was forced to beach the "Morrissey" to replace the propeller which had been lost. After hurried repairs they passed through Bering Strait, and headed westward through the Arctic Ocean to collect fish. At last reports the expedition was unable to reach Wrangle Island and was forced by ice to head south.

PREPARATIONS FOR A 1929 SIBERIAN EXPEDITION.—In order to make the necessary arrangements for an expedition into Siberia in 1929, Mr. William J. Morden, field associate in mam-

mology of the American Museum, has recently sailed for Russia in order to confer with the officials and scientists at Moscow and Leningrad. It is Mr. Morden's plan to prepare this fall for the expedition next summer, when he hopes to collect specimens of the rare Siberian tiger (*Felis longipilis*), the saiga antelope (*Saiga tatarica*), the Altai wapiti or stag, *Ovis ammon* (the big horn sheep of southern Siberia), and other lesser animals. After his arrangements in Russia are completed, he will return to the United States in order to outfit for his 1929 expedition. Mr. Morden was the leader of the Morden-Clark Asiatic Expedition which, in 1926, crossed Asia from Kashmir to the Trans-Siberian Railroad and Peking. At that time his expedition collected *Ovis poli*, ibex, and other specimens, and was captured by Mongols while making an effort to cross the Gobi Desert. An article by Mr. Morden descriptive of his experience with *Ovis poli* is published in this number of NATURAL HISTORY Magazine.

THE TYLER DUIDA EXPEDITION sailed from New York for Para, Brazil, on July 21. From Para the party will travel up the Amazon by river steamer to Manaos on the Rio Negro. Smaller boats will take them farther into the north of the Amazon Basin to Mount Duida, across the Venezuelan border. Here they will spend several months in intensive collecting and making a reconnaissance, biological and geological, of the region. The members of the expedition are Mr. G. H. H. Tate, leader, Mr. Sydney Tyler, Jr., historian and photographer, whose generosity made the expedition possible, Mr. Raymond S. Deck, ornithologist, and Mr. Charles Hitchcock, geologist.

A RECENT LETTER FROM BARNUM BROWN, curator of fossil reptiles, tells of continued work at Folsom, New Mexico, by the joint expedition of the American Museum of Natural History and the Colorado Museum of Natural History.

He says:

So far, nine arrows have been recovered, one complete, and during the excavation seven skeletons of the extinct bison *B. taylori* have been recovered. These include male and female skeletons. Two-thirds of the quarry, which is sixty feet square, have been exhausted, but it is probable that other artifacts will be encountered in the remaining portion of the quarry. These artifacts are of the finest workmanship in any stone culture so far discovered in America, and there is no doubt of their definite association and contemporaneity with an extinct species of bison.

#### EDUCATION

A NEW SERIES OF EDUCATIONAL FILMS AND TALKS for parents and their children has been prepared by the education department of the American Museum for Saturday afternoons dur-

ing the season of 1928-1929, beginning October 6 at 3:30 o'clock.

The lectures, illustrated with slides and motion pictures, present companion subjects to those offered in the School Children's Lectures, and correlate closely with the public school courses of study, but at the same time contain much of interest to adults as well as to children. The topics will include natural history, exploration, and American history.

CHILDREN'S FAIR, OCTOBER 18-21.—To en-

Nature League, American Museum of Natural History.

#### THE NEW RESTAURANT IN THE AMERICAN MUSEUM

After several months of planning and preparation, the American Museum on July 25 opened its new restaurant on the second floor of the main building.

Restful, attractive surroundings, quick service, and good food at cost for visitors and employees, have been especially sought by the Museum in



The model restaurant recently opened on the second floor of the American Museum

courage agriculture, nature study, and conservation, the School Nature League is planning to bring together for public display in Education Hall at the American Museum a series of exhibits showing the garden and nature work of New York City children. Schools and organizations working with boys and girls from all boroughs of New York City, as well as any New York City resident 18 years of age or under, are invited to take part. The Fair has the combined and coordinated support and facilities of the American Institute, School Nature League, and the American Museum.

Exhibits will be judged on the basis of their educational value and prizes amounting to \$2758 will be awarded. All communications should be addressed to Mrs. M. C. Coit, School

establishing this model dining hall. It will accommodate one hundred people, and has been furnished with specially designed maple Windsor chairs and tables that combine comfort and beauty with necessary durability, while the woodwork is of old seasoned cherry, rubbed down with a natural finish.

In solving the problems of organizing a dining room that would be *en rapport* with the atmosphere of the Museum and its clientele, Miss Marion Jellicorse, the dietition-manager, not only drew upon her own wide and varied experience in designing tea rooms to fit particular needs, but she also procured the advice of leading hotel and restaurant men, members of the staff of *Good Housekeeping*, and managers of tea rooms of other museums, with the result that



the dining room has rapidly become a most attractive and popular rendezvous.

Societies and organizations affiliated with, visiting, or planning to hold meetings at the American Museum or in its vicinity are assured a cordial welcome.

#### THE LOUVAIN LIBRARY

AT THE INAUGURATION OF THE LOUVAIN LIBRARY, held July 4, Baron Ludvic Moncheur, Count Guillaume de Grunne, and Dr. Henri Schouteden represented the American Museum. During the ceremonies the representatives announced that the American Museum was presenting to the Louvain Library a complete set of the Museum's publications, including a bound set of the reports on the Museum's expedition to the Congo.

#### THE NEW HOME OF THE EXPLORERS' CLUB

Explorers are at last to have a club house in New York City in keeping with their importance. It will be a modest club house as such things go in the great city, but a thoroughly modern one, fireproof, commodious, and situated near the West Side museum groups, that is, between the American Museum of Natural History, and the American Geographical Society and the Museum of the American Indian, and close to the educational center at Columbia University. The site is at 544 Cathedral Parkway, on the south side of the street, about two hundred feet east of Broadway. It is on a plot fifty feet wide and seventy-one feet deep, and will rise eight stories in height.

The new club house will have a small lecture hall to accommodate three hundred persons. This is on the ground floor with lobby and coat rooms and lavatories so arranged that it may be used by those desiring a small meeting hall without interfering with the affairs of the club.

The second floor will house the James B. Ford library of exploration, a collection of great value to all students of natural history, geography, and the many activities allied with the work of the explorer. A librarian is in charge of this collection of books. On this floor is also located the large club lounge.

The third floor will contain the residents' lounge, card rooms, and some living rooms.

The fourth floor has already had space leased by The American Alpine Club, and has the regular club housing which is also carried up to the eighth floor.

The club house will have sixty rentable rooms, all sunny, all with running water, phone connections, and furnished in the best club style.

Each floor will have a bank of showers, and a bath tub, these being in outside rooms as well. There will be no dark corners in the club house and it should be an ideal home for the bachelor, or the man temporarily residing in the city.

As for a time at least the club membership may not fill the entire house, surplus rooms will be leased to desirable tenants who are satisfactory to the renting committee.

One of the practical features about the new club house, a feature that explorers will appreciate, is the installation of large steel locker rooms for the stowage of equipment and other gear. These locker rooms will be available to the members. A breakfast room in the basement will afford breakfast and light lunches when desired by residents.

The new club house will be ready for occupancy on January 1, 1929.

#### BELGIAN TRIBUTE TO CARL AKELEY

BRONZE MEMORIAL TABLET FOR CARL AKELEY'S TOMB.—Permission to place a commemorative tablet of bronze on the tomb of the African explorer, Carl Akeley, who lies buried where he died in the heart of the Belgian Congo, has been requested by the Belgian Government in a communication received by the explorer's widow, Mrs. Mary L. Jobe Akeley.

M. Jaspar, Prime Minister of Belgium and Minister of the Colonies, has made the request through His Highness Prince Albert de Ligne, Belgian Ambassador to the United States. M. Jasper states that "this action is desired as a token of the admiration of the Belgian Government for the great American scientist" and that he wishes Mrs. Akeley to consider the offer as a kind tribute to the memory of her husband and to herself.

Carl Akeley died suddenly on November 17, 1926, on the high slopes of Mount Mikeno in the Parc National Albert of the Belgian Congo, where he and Mrs. Akeley had undertaken to fulfil a mission from Albert, King of the Belgians. Mrs. Akeley, aided by the other members of the party and her black boys, prepared Mr. Akeley's grave in the solid volcanic rock and, using the only materials available, built a coffin of native mahogany, metal-lined, and upholstered with woolen blankets. An eight-foot stockade of mahogany posts was erected around the burial plot to prevent the encroachments of the jungle. A great slab of concrete bears the explorer's name and the date of his death. The cement for this slab was carried by Mrs. Akeley's black boys from a government post a hundred miles distant.

The bronze tablet which the Belgian Govern-



ment now proposes to dedicate to Carl Akeley's memory, will surmount this cement slab. On a future expedition, Mrs. Akeley plans personally to supervise the placing of the tablet on her husband's grave.

#### HISTORY OF THE EARTH

DR. PAUL WOLDSTEDT, one of the forty geologists of the Prussian Geological Survey, arrived in New York on Monday, August 13, to conduct during the next two and a half months extensive studies of the glacial deposits in the northern portion of the United States and the southern part of Canada. While here, he will be the guest of various specialists in different parts of the continent.

Following his visit to the United States Geological Survey at Washington, D. C., Doctor Woldstedt will call on Dr. Geo. H. Ashley, state geologist of Pennsylvania, to view the river terraces along the Susquehanna River and those along the Ohio and its tributaries near Pittsburg. Then he will pass to Ann Arbor, Michigan, where he will be the guest of Dr. Frank Leverett, glaciologist of the U. S. Geological Survey. From Ann Arbor he will go to Chicago University to be the guest of Prof. E. S. Bastin. Thence to the University of Wisconsin where Prof. F. T. Thwaites will show him the typical Wisconsin drift deposits. At the University of Minnesota, at Minneapolis, he will be the guest of Prof. S. W. Sardeson. At Iowa City he will call on Prof. G. F. Kay, state geologist, who will show him the varied glacial deposits of Iowa. Prof. R. C. Moore, state geologist of Kansas, and Dr. M. M. Leighton, state geologist of Illinois, will conduct Doctor Woldstedt over the glacial deposits in their respective states. In Canada Doctor Woldstedt will be the guest of Prof. A. P. Coleman of Queen's University, Toronto, and on returning to New York he will be the guest of Dr. Rudolph Ruedemann at Albany.

While in New York City on August 14 and 15, Dr. Chester A. Reeds, curator of geology in the American Museum, conducted Doctor Woldstedt over the ground covered by the glacial lake clays and the terminal moraine deposits in the Hackensack and Passaic basins in New Jersey and along the Hudson River to the Highlands of the Hudson at Bear Mountain. Doctor Woldstedt is making these glacial studies in America in connection with the revision of the glacial map of northern Germany.

#### EXTINCT ANIMALS

In a recent number of the German periodical *Aus der Heimat*, (41 Jahrgang, Heft 5), Doctor

Berckhemer, of Stuttgart, describes the recent discovery of remains of a giant deer near Steinheim. The skull with its giant antlers was well preserved and, with part of the neck, was recovered from gravels of Pleistocene age in a sand-pit. This animal is closely similar to the great extinct Irish deer, a skeleton of which is mounted in the American Museum's Hall of the Age of Man.

Reviewing the various discoveries of giant deer in Germany, Doctor Berckhemer points out that there was a definite increase in the span of the antlers during the course of the Pleistocene Epoch. The earliest forms had an antler spread of little more than a yard, while in the most recent German specimens this span is more than six feet.

DR. W. D. MATTHEW, professor of palaeontology at the University of California, and former curator of the department of vertebrate palaeontology in the American Museum of Natural History, returned to Berkeley August 1 after two months spent in the Museum. While in the Museum he worked on his forthcoming memoir of the Paleocene Mammalia of New Mexico. After many years devoted to these earliest known mammals of the Age of Mammals, his work is now nearing completion. He plans to return next summer to finish his studies.

#### NEW BOOKS

*A Catalogue of the Mesozoic Mammalia in the Geological Department of the British Museum.* By George Gaylord Simpson.

This very important work has just been published by the British Museum. Though the fossil mammals of the Tertiary period are fairly well known by hundreds of nearly perfect skeletons, the mammals of the Mesozoic Age, or the Age of Reptiles, are known only by a very few jaws and teeth and one or two other scraps. In these early times mammals probably played no more important part in the earth's economy than do moles and shrews today, and as a result their fossil remains are very rare.

Simpson has again gone over the whole field and reexamined every known specimen with later appliances and a little more up-to-date knowledge, and has been able to throw a good deal of new light on these early forms.

Doctor Simpson was a student at Yale, where he studied paleontology under Professor Lull, who was himself a student of Professor Osborn's. This book on Mesozoic mammals is of such remarkable merit that Simpson is

to be congratulated on his achievement.

—R. BROOM.

#### SCIENCE OF MAN

DR. GEORGE VAILLANT has just returned from a preliminary archaeological survey of Middle America, supported by Mr. Clarence L. Hay. The outstanding result was the obtaining of a permit from the Mexican Government for excavations in the Valley of Mexico for next winter, political conditions permitting. At the invitation of the Carnegie Institution, Doctor Vaillant carried out a small excavation at their site of Uaxactun, Peten, Guatemala, that yielded important information on the early history of the Maya. He was enabled, through the courtesy of the Mexican Government, to bring back a small synoptic collection of the "Archaic" cultures of the Valley of Mexico. He also visited a number of sites on the highlands of Mexico and Guatemala, as well as in British Honduras and the Peten district of Guatemala.

#### PAST, PRESENT, AND FUTURE OF SCIENCE

THOMAS A. EDISON, as the greatest inventor of the age, was the central figure of the wonderful gathering of men of achievement at Mr. George Eastman's home on Monday, July 30, when the first demonstration was given of a new camera with which an amateur photographer can take moving pictures that will reproduce a subject in natural colors. Marvelously life-like color pictures were taken of Edison, both seated with men like Mr. Eastman or Mr. Ochs of *The New York Times* beside him, or seated alone in a contemplative mood quietly enjoying the last puffs of a cigar. This long exposure of the face of the world's greatest inventor of all time is in itself of priceless value. Imagine a hundred years hence placing before an audience the portrayal of the lineaments and facial characteristics of Thomas A. Edison! His pose when paired with President Osborn of the American Museum is interesting as a matter of contrast, for in trying to make Mr. Edison hear and understand, President Osborn's face presents every variety of expression and is full of movement and animation, while Mr. Edison is serenely contemplative and quietly thoughtful because he cannot hear a single word unless it is shouted into his best ear. A charming color picture is that of Mr. Ochs drawing Mr. Edison to him by the left shoulder and shouting into his right ear; this was one of the triumphs of the many Koda-colour achievements of the morning.

It appears that Mr. Edison recently visited the American Museum in his quiet way, and was especially impressed with the series of prehistoric halls explaining the ages of the past. Among the few but memorable words when he said "good-bye" to President Osborn on Monday evening were the following:

*You are interested entirely in the past: you think in millions of years. Mr. Eastman here is entirely interested in the present: he thinks of all that is going on today. I am always thinking of the future and what future discovery may bring forth. Together we three represent all the phases of human thought.*

#### NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total number 10,550.

##### *Annual Members*

Mesdames LOUIS V. DAVISON, STEWART ELLIOT  
JOHN L. KUSER, JR.

Misses MARY E. HARDIE, ABBY R. HOWLAND.  
Dr. L. MILLER KAHN.

Messrs. JOHN ELLIOT, HARRY F. EVANS, ROBERT P. KEHOE, C. KENDRICK MACFADDEN, GILBERT W. PAUL, ABRAHAM RACHLIN.

##### *Associate Members*

Mesdames PETER A. BUNGART, ELEANOR BARBOUR COOK, S. P. JOCELYN

Misses VIRGINIA MILLER, BAB OPPENHEIMER, FRANCES S. WESTON.

Rev. CYPRIAN MENSING.

Prof. GEORGE L. HOWE, J. ARTHUR THOMSON.  
Doctors JUDSON DALAND, E. P. DEBELLARD, HENRY JACKSON, JR., JAROMIR SAMAL.

Messrs. HEINRICH J. BREMERS, EPES D. CHASE, A. D. COMBE, CLARENCE N. CONE, MORTON B. CURLEY, C. E. DANT, DONALD M. DAVIDSON, GORDON DEXTER, GEORGE T. DUNCAN, DONALD R. GRIFFIN, JOHN V. HASTINGS, JR., JAMES C. HAZLETT, FORBES HEERMANS, GEORGE R. HEYL, WILLIAM C. HIGGINBOTTOM, PETER JOSEPH, JOHN B. LEWIS, DONALD A. MACKENZIE, CHAUNCEY C. NASH, W. H. POTTS, MILFORD REED, EDWARD A. RENWICK, PRESCOTT D. REYNOLDS, JOHN RICHARDSON, JR., A. C. ROGERS, EARL W. ROLLMAN, JAMES A. SHEPARD, HUGH SPENCER, R. E. STADELMAN, CHARLES J. TETLOW, W. J. THORROWGOOD, C. ROY WATSON.

Master ARCHIBALD YOUNG.